Investigating and Improving Designs for Supporting Professional Development
Facilitators' Learning

By

Jonee Wilson

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Approved:

Paul Cobb, Ed.D

Kara Jackson, Ph.D

Leona Schauble, Ph.D

Ilana Horn, Ph.D

For Jonathan, Adelaide, Rhoda, and Verna, who support me in all that I do

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CHAPTER I

INTRODUCTION

Policy documents such as the *Common Core State Standards* in mathematics (Common Core State Standards Initiate, 2010) and the National Council of Teachers of Mathematics' *Principles and Standards for School Mathematics* (NCTM, 1989; 2000) outline ambitious goals for student learning and call for a reconceptualization of effective mathematics instructional practices. Achieving the goals for learning and the vision of teaching outlined in the *Standards* requires that teachers develop sophisticated knowledge and practice. Given the significant learning involved, teachers need substantial support and High-Quality Professional Development, HQPD (Stein, Smith, & Silver, 1999; Thompson & Zeuli, 1999).

By HQPD, I mean professional development (PD) designed with the goal of supporting teachers to radically reorganize their practice and develop inquiry-oriented teaching practices that support all students' engagement in rigorous mathematics activity. Though several studies clarify *what* HQPD entails (Borko, Jacobs, & Koellner, 2010; Borko, Koellner, & Jacobs, 2014; Desimone, 2009), district leaders must know the *how* and the *why* of designing and leading HQPD if they are to provide such PD for teachers. However, research provides little guidance in terms of what PD leaders need to know and be able to do in designing and leading HQPD (Borko, Koellner, & Jacobs, 2011; Elliott et al., 2009) and even less in terms of how to support the development of such expertise. This dissertation contributes to the efforts to understand what it takes to support PD facilitators in designing and implementing HQPD.

In this dissertation I report on a retrospective analysis of a design experiment, conducted

in partnership with the leaders of a large U.S. urban district, that seeks to examine what PD facilitators need to know and be able to do in order to design and implement high-quality professional development (HQPD) and how to design PD to support the development of such expertise. The collaborative work conducted with the focal district, is a case of supporting a district in developing the capacity to provide such PD for teachers by investing in the development of the district content specific coaches' professional development facilitation practices.

Using content specific coaches as a way of supporting teacher development has become increasingly common in the U.S. In fact, the focal district hired three district-level mathematics coaches and appointed them to be in charge of planning and facilitating teacher PD. Unfortunately, despite the critical role that PD facilitators (like these coaches) play in supporting instructional improvement at scale, there is little to support them in their efforts to develop the expertise needed to design and lead HQPD. In reporting on this design experiment, my dissertation describes the work of developing, testing, and revising conjectures about both the learning process and the means of supporting the process of developing PD facilitator expertise. I examine this work of investigating and improving designs for supporting these coaches as a means for developing theory about how to support PD facilitators more generally. This resulting theory will constitute the rationale for revisions and improvements to the design of supports for PD facilitators that I will propose to be examined in future research.

This dissertation is organized into five chapters. In chapter II, I provide a more detailed statement of the problem that this study aims to investigate and outline my research questions. I also describe the conceptual framework and provide a review of the literature that guided the design and analysis of the study. In chapter III, I provide an overview of the research design and

methods. More specifically, I describe the coaches initial practices, the goals for the coaches'

learning, the design of the supports we provided the coaches, and the data collection and data

analysis processes. In chapter IV, I report my findings which focus on the PD practices the

coaches' developed that related to immediate and long-term goals we identified for our work

with them. I also reflect on ways that the coaches' development could have implications for

potential modifications to the design of supports for their learning and provide recommendations

and additional insights gained from my analysis. Finally, in chapter V, I discuss larger

implications for the goals for PD leaders' learning and the means of supporting this learning

more generally (i.e. beyond the context of this study). I also take a step back and reflect on the

extent to which my findings have implications for supporting the development of district

capacity for instructional improvement at scale.

CHAPTER II

SITUATING THE STUDY AND ITS GOALS

The *Common Core State Standards* in mathematics (Common Core State Standards Initiate, 2010) and the National Council of Teachers of Mathematics' *Principles and Standards for School Mathematics* (NCTM, 1989; 2000) emphasize the importance of students achieving conceptual understandings of key mathematical ideas, participating in mathematical argumentation, and making connections between multiple mathematical representations, in addition to mastering procedural fluency. These learning goals are beginning to be reflected in new high-stakes state standardized tests that are currently being released and that are highly consequential for students, schools, and districts. The new Common Core Standards along with these changes in assessments pose a challenge for districts as they call for a reconceptualization of effective instructional practices from instruction that focuses primarily on procedural fluency absent conceptual understanding and they require that teachers develop sophisticated knowledge and practices.

Teaching that aims at the goals for students' learning outlined in the Core Standards has been called ambitious because these learning goals are more demanding and require a lot more of teachers than the typical exclusive focus in the past on procedural fluency (Kazemi, Franke, & Lampert, 2009; Lampert, Beasly, Ghousseini, Kazemi, & Franke, 2010; Lampert & Graziani, 2009). Now teachers are expected to support students' development of robust and enduring conceptual understandings in mathematics by building on their current thinking (Franke Kazemi, & Battey, 2007; Jackson & Cobb, 2010; Lampert et al 2010; Stein, Smith, Henningsen, & Silver,

2000; Thompson, Philipp, Thompson, & Boyd, 1994). Teaching that aims at these goals has also been called equitable instruction (Jackson & Cobb, 2010) because it involves supporting all students' participation in rigorous mathematic activity by being responsive to their needs (Boaler, 2002). Instruction of this type differs significantly from typical mathematics instruction in the U.S. (Stigler & Hiebert,1999) and thus requires substantial teacher learning. It calls for a qualitatively different and deeper understanding of mathematics and student reasoning than teachers typically demonstrate (Ball, 1996; Cohen & Ball, 1990; Schifter, 1998; Stein, Grover, & Henningsen, 1996). For this reason, ambitious and equitable instruction involves a complete reorganization of teachers' practices, knowledge, and strongly held beliefs (Stein et al., 1999; Thompson & Zeuli, 1999). Given the significant learning involved, teachers, in turn, need substantial support and HQPD.

The findings of several studies clarify some of the key characteristics of HQPD (Borko et al., 2010; Borko et al., 2014; Desimone, 2009). As Jackson and Cobb (2012) summarized, current research on teacher learning indicates that high-quality professional development is sustained over time, supports the development of collaborative teacher communities, focuses on central issues of instruction, and is organized around the instructional materials that teachers use in their classrooms (see Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009, Garet, Porter, Desimone, Birman, & Yoon, 2001; Kazemi & Franke, 2004; Little, 2003). HQPD is also inquiry-oriented and learner-centered and incorporates aspects of school and/or classroom contexts as a means of attending to the settings in which teachers work (Darling-Hammond & McLaughlin, 1995; Putnam & Borko, 2000; Stein et al., 1999). A primary goal of HQPD is to support teachers in developing their understanding of content while helping them learn how to elicit and interpret students' ideas, examine student work, and use what they learn about

students' to inform their instructional decisions and actions (Borko et al., 2010; Cobb, Wood, & Yackel, 1990; Grossman, Brown, Schuldt, Metz & Johnson., 2013; Lampert et al., 2013; Simone & Schifter, 1991). In addition, the instructional practices that the PD is designed to support are often explicitly modeled during high-quality professional development sessions (Borko, et al., 2010; Darling-Hammond & McLaughlin, 1995; Knapp, 2003; Putnam & Borko, 2000; Stein et al., 1999).

Research indicates that PD with these qualities provides opportunities for teachers to engage in collective inquiry about issues related to both content and pedagogy by incorporating activities that enable teachers to experience the target instructional practices as learners and then to reflect on their own current instructional practices in relation to the target practices. Research on HQPD that shares these features forms a basis for deriving design principles for HQPD. However, district capacity to support teachers in developing and sustaining ambitious and equitable teaching practices requires more than knowing what HQPD looks like. In addition to knowing *what* high-quality professional development entails, district leaders must know the *how* and the *why* of designing and leading HQPD if they are to develop the capacity to provide such PD for teachers.

Many schools and districts have addressed the challenge of providing HQPD for teachers by investing in content-focused coaches as professional development leaders (Coburn & Russell, 2008; Darling-Hammond, Wei, Andree, Richardson & Orphanos, 2009; Gibbons, 2012; McLaughlin & Talbert, 2006). Because mathematics coaches can provide on-site and job-embedded training in which teachers co-participate with someone who has expertise in mathematics instruction, coaching is a promising approach for supporting teachers' learning and professional growth both in groups and individually (Gibbons, 2012). Activities coaches might

facilitate with groups of teachers (e.g., via facilitated teacher collaborative time or in school- or district-level PD) include doing mathematics, examining student work, analyzing classroom video, and rehearsing aspects of practice. Activities that coaches might facilitate with individual teachers include co-teaching, modeling, and observing instruction and debriefing challenges of implementation (Borko et al., 2011; Franke et al., 1998; Gibbons, 2012; Grossman et al., 2009a; Horn, 2010; Kazemi & Hubbard, 2008; Schifter, 1998; van Es & Sherin, 2010). For schools and districts investing in content-focused coaching, supporting coaches' development of productive practices for supporting teachers' learning is therefore a key aspect of capacity for instructional improvement.

Unfortunately, relatively little work has been conducted to unpack and outline what expertise in designing and leading HQPD entails (Borko et al., 2011; Elliott et al., 2009). Specifically, little is known about what PD facilitators need to know and be able to do in order to adequately support teachers in developing ambitious and equitable teaching practices. It is clear that the development of relatively accomplished instructional practice is necessary, but not sufficient, for developing effective facilitator practices (Borko, Jacobs, Eiteljorg, & Pittman, 2008; Elliott, et al., 2009).Moreover research does not yet distinguish between what one needs to know and be able to do in order to implement ambitious *facilitating* practices (e.g., in the context of teacher PD) and what one needs to know and be able to do in order to implement ambitious *teaching* practices (e.g., in the context of a mathematics classroom).

In addition to knowing what this expertise entails, it is also essential to know how to support the development of such expertise. According to recent reports, there are only a small number of investigations that provide information about supporting PD providers who in turn implement already established PD programs with teachers (Borko et al., 2014). In light of these

considerations, there is a pressing need for studies investigating what it takes to support PD facilitators in *designing and* implementing HQPD. This is especially true given that even well-established PD programs must be adjusted to local contexts and make use of internal resources in order to be sustainable (Goos, Dole, & Makar., 2007; Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003). Thus, in order to support the development for district capacity for instructional improvement, we need to understand 1) the expertise needed to design and implement HQPD, and 2) how to support PD facilitators in developing this expertise. My dissertation seeks to investigate both of these issues. In the following section, I outline the research questions that guided my dissertation analysis.

Research Questions

My dissertation work investigates how to support districts in building the capacity to provide HQPD by examining a design for supporting coaches' learning that was enacted in collaboration with leaders of the focal district. Specifically, my guiding research questions were how might mathematics instructional coaches be supported to design and lead HQPD for mathematics teachers? What forms of PD practice did the coaches develop (specific to the identified goals which are outlined in the following chapter)? How did our design of supports for the coaches help them in developing these practices or in making progress toward the identified goals for their learning? What does the coaches' development imply for the revision of our goals and conjectured means of supporting their learning? Thus, in my analysis, I investigate both the process for developing facilitator expertise and the supports for this learning process. My analysis of the work with the three coaches in the focal district will contribute to the

development of a practice-specific PD theory and will serve as a rationale for my proposed revisions to designs for supporting PD facilitators' learning more generally.

Conceptual Framework and Brief Review of Relevant Literature

Supporting teachers in developing ambitious and equitable practices through PD involves facilitation that is grounded in classroom practices and fosters the development of learning communities (Borko et al., 2010). Facilitating HQPD in these ways is challenging as it requires a deep understanding of high-quality instruction, the participating teachers' current practices, and the means of supporting their learning. Unfortunately little research has focused specifically on designing and facilitating HQPD, and even less on supporting professional development leaders' learning (Borko et al., 2014; Even, 2008; Stein et al., 1999). In the following paragraphs, I first review this small body of research literature to clarify what is known about high-quality PD facilitation. Then I draw on the findings of this literature and extrapolate from literature on professional development, teacher learning, and teacher education that aims at ambitious teaching practices (e.g., Grossman et al., 2009a) to unpack more specific details about what PD facilitators might need to know and be able to do in order to design and facilitate HQPD. Finally, I develop conjectures about supporting facilitators' development of these capabilities by drawing on and extrapolating from the findings from the literature.

What is Known about HQPD Facilitation

The existent small body of research that has focused specifically on designing and facilitating HQPD suggests that PD facilitators need to be able to identify and select mathematical tasks that are appropriate for teachers, that generate multiple representations and

solution strategies, and that prompt in-depth conversations (Elliot et al., 2009). PD facilitators must be able to orchestrate discussions to explore topics relevant to teaching, elicit teachers' ideas, and scaffold teachers' use of evidence-based reasoning (Borko et al., 2011). Facilitators must also be able to foster community, support productive interactions, and establish norms for communication and participation (Koellner, Jacobs, & Borko, 2011). In addition, PD facilitators must be able to support local goals and interests and be responsive to teachers' needs (Borko et al., 2011).

Although this research has begun to clarify what facilitators need to know and be able to do, its findings and implications are at a relatively coarse gain size. Thus, it does not unpack the details of practices such as: What is important for facilitators to consider when selecting tasks? What makes for a task that will prompt in-depth conversations? What specific skills or facilitation moves are important for facilitators in orchestrating discussions? What are considered productive ways for teachers to participate? Which particular norms are important to establish in trying to support specific types of interactions with teachers? In the following section, I therefore extrapolate from the findings of this small body of research by drawing on literature on professional development, teacher learning, and teacher education that aims at ambitious teaching practices (e.g., Grossman et al., 2009a) to outline what facilitators might need to be able to do as well as what they need to know in order to do these things. I then go on to develop conjectures about supporting facilitators' development of these capabilities.

What Literature *Indicates* about What PD Facilitators Need to Know and Be Able to Do

Literature on HQPD indicates that facilitators need to be able to establish clear and productive goals for the teachers' learning (Ball, Sleep, Boerst, Bass, 2009; Grossman,

Hammerness, & McDonald, 2009; Schifter & Lester, 2005), select and facilitate appropriate activities for supporting teachers in attaining these goals (Borko et al., 2014; Kazemi et al., 2011; Koellner et al., 2011), establish and cultivate specific norms for participating in PD (Elliot et al., 2009; Shulman, 1986), and orchestrate productive discussions (Borko et al., 2014; Elliot et al., 2009; Schifter & Lester, 2005). I discuss each of these capabilities in the following paragraphs and consider the facilitator knowledge that might be necessary in developing and implementing them.

Establishing goals for teachers' learning. The literature on HQPD suggests that facilitators who design PD need to be able to establish clear and productive goals for the teachers' learning and that these goals are essential to the work of planning and leading HQPD. For example, the goals of eliciting and responding to student thinking and developing instructional autonomy (i.e. learning to think through how to solve instructional problems on their own) were repeatedly highlighted as central in supporting teachers in developing ambitious mathematics teaching practices through professional development (Cobb et al., 1990; Fennema et al., 1996; Grossman et al., 2013; Lampert et al., 2013; Simon & Schifter, 1991).

In order to establish productive goals for teachers' learning, PD facilitators need to view PD as a means of supporting teachers in developing increasingly sophisticated practices rather than as a means of rectifying deficiencies in teachers' current practices (Gibbons, 2012). Facilitators also need to know how to assess teachers' current practices and understand the participating teachers' perspectives and deeply held ideas (Schifter & Lester, 2005), which will help facilitators as they think through constructive and practical next steps for teachers' development of more sophisticated practices. In addition, facilitators must learn to be deliberate in considering their overall goals for the PD sessions while planning activities for teachers and

move beyond merely getting through prescribed activities (Schifter and Lester, 2005). Ideally all of the activities that facilitators plan and implement with teachers in PD would be designed to support efforts towards making progress on these goals.

Selecting and facilitating appropriate activities. Literature on HQPD indicates that facilitators need to be able to design and/or select mathematical problems and teacher analysis tasks and make talk moves that promote conversations and interactions that support major shifts in instructional practice (Borko et al., 2014; Kazemi et al., 2011; Koellner et al., 2011). The nature and focus of these conversations should be designed to engage teachers in mathematics and self-reflection or inquiry into instructional practice. In fact the activities and processes that have great potential to support teachers in making such shifts include engaging teachers in the content that they teach, examining representations of classroom practice, rehearsing the ambitious practices teachers are being supported to learn all while working collaboratively with other teachers (Cobb et al., 1990; Fennema et al., 1996; Grossman et al., 2013; Lampert at al., 2013; Schifter & Fosnot, 1993).

For example, providing opportunities for teachers to complete tasks as students could support teachers in recognizing the big and important ideas that they would need to press on and emphasize during discussions of students' solutions to the tasks, while also giving them an opportunity to consider possible misconceptions and mistakes that students might make while completing the task. In examining representations of classroom practice, teachers might learn to distinguish between productive and unproductive instructional practices, to value student ideas and to develop a practice of focusing their lesson planning and instructional practices on student thinking. Providing opportunities for teachers to participate in rehearsals and other activities that approximate targeted practices support teachers in viewing the practices as feasible, in

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developing routines for enacting them (e.g., generating a list of sentence stems/questions to ask students), and in anticipating the types of impromptu decisions they might have to make while implementing them in their classrooms. Also providing opportunities for teachers to work in cooperative groups helps build community and encourages teachers to make their decision-making, problem-solving, and thought processes public which supports the teachers who share by providing opportunities for them to think through, rationalize, and make sure their processes make sense, while supporting the teachers who listen by giving them opportunities to critique what is shared, compare it to what they did or would do, and give feedback.

Designing PD in these ways moves PD beyond being a place where teachers are merely updated on new tools and strategies (e.g., how to make use of a document camera in a mathematics classroom or ways to randomly select students for participation) to a setting in which teachers examine, investigate, and prepare to implement instructional practices (e.g., facilitating whole-class discussions in which students provide thorough explanations, talk about important mathematical ideas, and make connections to underlying ideas and to each other's ideas). In order to design and lead this type of PD, facilitators need to have developed the practices that they are supporting teachers in developing and have an understanding of teachers' perspectives in order to select representations of practice that will encourage self-reflection and inquiry into instructional practice by setting up clear distinctions between more and less productive examples of practice. Facilitators must not only understand the mathematics that the teacher participants are responsible for teaching and be accomplished in the targeted practices that they are supporting teachers in developing, but must also understand the participants' perspectives and deeply held ideas in order to promote deeper reflection and expanded insight (Schifter & Lester, 2005). The combined understanding of the mathematics that teachers are

expected to teach, the practices that they as facilitators are supporting teachers to develop, and the perspectives and beliefs that teachers typically have will help facilitators in selecting and facilitating activities that are designed to support teachers in achieving the goals of the PD. Additionally it is important that facilitators understand *why* teachers should engage in mathematics and self-reflection or inquiry into instructional practice during PD (Koellner et al., 2011). This understanding helps facilitators not only select appropriate activities but also determine where and how to place emphasis on specific practices and aspects of instructional practices while supporting teacher development in their PD facilitation.

Establishing norms. Literature on HQPD indicates that facilitators need to be able to establish and cultivate certain social norms (i.e. general ways teachers engage with one another) for their work with groups of teachers during PD. In fact Dean (2005) identified 4 specific types of norms of professional teaching communities: the norms of general participation (i.e. the evolving participation structure within the group), the norms for pedagogical reasoning (i.e. the norms that become established as the teachers both reflect on their instruction and plan for instruction), the norms for mathematical reasoning or sociomathematical norms (Elliot et al., 2009) (i.e. the forms of mathematical reasoning and argumentation that become normative as teachers explore particular mathematical domains), and the norms for strategic reasoning (i.e. the evolution of teachers' understanding of the institutional setting and its influence on their teaching of mathematics).

For example, establishing questioning and critiquing each other's thinking and having professional debate as an appropriate norm of general participation is an important part of PD facilitation. And developing ways of cultivating these social norms so that teachers are not only comfortable interacting with each other in these ways but come to value them over the often

unproductive politeness that is typically demonstrated during PD sessions is essential to the work of facilitating HQPD. As a further example establishing sociomathematical norms, such as sharing typical student thinking or common student strategies (even if they may be problematic) while solving mathematical tasks, is an important part of PD for mathematics teachers. And supporting teachers in understanding that contributing in these ways is valued over demonstrating that they, as mathematics teachers, can get the "right answer" is also essential to the work of facilitating HQPD.

In order to establish such norms, PD facilitators need to understand teachers' perspectives. This understanding can help facilitators anticipate and develop ways of handling any tensions that may arise in PD while teachers work with their colleagues.

Orchestrating productive discussions. Literature on HQPD suggests that facilitators need to be able to orchestrate productive discussions (Borko et al., 2014; Elliot et al., 2009; Schifter & Lester, 2005). Specifically, they need the ability to appropriately and adequately press on teacher ideas and build on teacher contributions (Cobb et al., 1990; Fennema et al., 1996; Grossman et al., 2013; Schifter & Fosnot, 1993). Pressing on teacher ideas differentially is central to leading HQPD because, again, it requires facilitators to identify clear learning goals for teachers (Kazemi and Stipek, 2001). It also requires facilitators to use specific talk moves such as rephrasing or revoicing teacher contributions, pressing for further explanation, and orienting teachers to one another's ideas (Chapin, O'Connor, O'Connor, & Anderson, 2009). Pressing productively is challenging as it involves highlighting some teacher contributions while dropping others (Jackson et al., 2015) and this is counter to traditional PD in which politeness is valued over professional debate and disagreement (Ball & Cohen, 1999).

More generally, how facilitators lead discussions is key to focusing teacher conversation on important mathematical ideas, helping teachers to unpack their typically procedural and incomplete reasoning, and supporting teachers in developing knowledge and practices that are integral to ambitious mathematics instruction, (Borko et al., 2014; Elliot et al., 2009). In order orchestrate productive discussions facilitators must understand the mathematics and/or the teacher practices being discussed. They must also understand and be able to anticipate teachers' perspectives in regards to the mathematics and teacher practices being discussed. Additionally, they must understand why such activities and discussions are productive for teachers to participate in. This combination of understandings helps facilitators anticipate questions teachers may ask and plan constructive questions to ask in order to push on teacher thinking during discussions. Facilitators must also be able to recognize teacher contributions that offer potential learning opportunities as they occur, then analyze, interpret, and weigh possible responses and potential consequences for these responses (Schifter & Lester, 2005).

These forms of expertise inferred from literature on HQPD make up the basis from which productive goals for the PD facilitators in this study were selected. I outline the specific goals for our work with the coaches in greater detail in Chapter III. In the following section, I extrapolate from the literature on HQPD and teacher education and make conjectures about the design of supports for PD facilitators' development of expertise.

Supporting PD facilitators' Development of Expertise

Findings from the literature on supporting complex professional practices for teachers indicates that when teachers' professional learning is centered on the sorts of ambitious practices that they are to develop, much of their everyday work becomes a source of constructive

professional development (Ball & Cohen, 1999; Grossman et al., 2009b; Lampert et al., 2010).

Also, learning in and from practice focuses on ambitious teaching in ways that enable teacher

educators to teach it and teachers to learn it (Kazemi et al., 2009). Therefore, I conjecture that

supporting PD facilitators in developing facilitator expertise would involve centering work done

in PD on core facilitator practices (e.g., engaging in specific planning and facilitating activities,

selecting the same materials and tasks that are to be used in upcoming PD, etc.), while also

making use of the materials that are essential to these practices. By core facilitator practices, I

mean aspects of facilitators' work that they are expected to do frequently and that, if done well,

has great potential in improving the overall quality of their work (Grossman et al., 2009b).

Centering work done in PD on core facilitator practices could mean following the example of

Koellner, Jacobs, and Borko (2011) who supported facilitators by engaging them in the same

mathematics tasks that they would use with teachers who, in turn implemented the tasks with

students. In other words, I conjecture supports for facilitators need to focus on what they are

expected to do in their professional work and should even make use of the materials and

resources that they would use in practice. PD designed to support facilitators in these ways is

said to be organized around "high-leverage practices" (Ball et al., 2009) while also staying close

to the practices (Ball & Cohen, 1999) of the facilitators.

The literature on supporting complex teacher practices also indicates that teachers'

classrooms are powerful contexts for teacher learning. Thus bringing ideas and events from the

classroom into the professional development context through the use of tangible artifacts is

essential to supporting teacher development of ambitious practices as they often highlight aspects

of classroom life that a teacher may not notice in the midst of teaching (Borko et al., 2008;

Sherin & Han, 2004; van Es & Sherin, 2010). Also representations (like the tangible artifacts

used to bring ideas and events from the classroom into PD) provide teachers with opportunities to develop ways of seeing and understanding professional practice (Grossman et al., 2009a). Therefore, I conjecture supporting PD facilitators' development of the expertise needed to design and lead HQPD would also involve modeling or providing opportunities to investigate representations (e.g., video recordings) of facilitation practices.

By demonstrating or providing images of the practices that they, as PD facilitators, are expected to develop there are opportunities for the facilitators to analyze and critique the practices being demonstrated in the representations, while also providing something concrete for them to reflect on and relate to while thinking about what may be problematic about their own current practices (Borko, Koellner, Jacobs, & Seago, 2011; Cobb et al., 1990; Fennema et al., 1996; Grossman et al., 2013; Schifter & Fosnot, 1993; van Es, Tunney, Goldsmith, & Seago 2014). Included in these opportunities to investigate representations of facilitation practices are opportunities to investigate their *own* facilitation practices. For example, opportunities to watch and discuss video recordings of themselves facilitating PD. By consistently pressing for justifications and explanations of why the facilitators do what they do (especially in light of their goals for teachers) there are opportunities for the facilitators to analyze and critique their own practices. These representations of practice may lead to discussions about the extent to which facilitators' views of PD facilitation and what is possible may have changed. These representations of practice may also spark conversations about what facilitators need (e.g., knowledge, skills, supports, and materials) in order to be able to implement the productive practices demonstrated in the representations (Koellner et al., 2011). These types of supports have been called pedagogies of investigation (Grossman et al., 2009a) because of the opportunities to examine, explore, and scrutinize depictions of practice.

Additionally, literature on supporting complex professional practices for teachers indicates that providing opportunities for teachers to plan, rehearse, enact, and reflect on ambitious teaching practices while working with a more knowledgeable other enables teachers to develop broadly applicable skills and knowledge through experimentation while providing a setting in which the more expert other can use teacher performances as a site for guiding collaborative examinations of ambitious practices and can press teachers on key questions and issues (Borko et al., 2011; Coburn & Russell, 2008; Elliot et al., 2009; Kazemi et al., 2009; Lampert et al., 2013). Access to expertise has even been associated with instructional improvement for teachers (Gibbons, 2012; Penuel, Riel, Krause, & Frank, 2009).

Therefore I conjecture that supporting PD facilitators would involve co-planning or co-leading activities and rehearsals with more expert or more accomplished others (Lave & Wenger, 1991). By rehearsals, I mean opportunities for the facilitators to tryout or run through the performative aspects of the practices they are learning while appropriately adjusting the challenge involved (Kazemi et al., 2009; Lampert et al., 2013). In the case of facilitators, co-participating and rehearsals may involve providing support as facilitators plan for, rehearse, enact, and reflect on the practice of knowing when and how to push back on teachers' contributions. Thus, in co-participating or rehearsing there should be opportunities to approximate the targeted practices. Furthermore, co-participation with individuals who have already developed the targeted practices can give rise to opportunities to learn and ask questions about aspects of the practices that are not necessarily made visible or explicit in the representation (and thus are not likely to be developed absent this work with an accomplished other). This could mean following the example of Elliot and her colleagues (2009) who

supported PD facilitators in selecting and sequencing potential tasks for mathematics teachers while collaboratively designing an upcoming mathematics teacher PD session.

Appropriately adjusting the challenge of the rehearsals may involve gradually reducing the advice, suggestions, and other support from the more expert other while facilitators enact various practices or it may involve having facilitators enact various practices in gradually more complex contexts (e.g., facilitators may start off rehearsing with more expert others playing "teachers", then rehearse with a group of peers/other facilitator playing "teachers", and then rehearse with a pilot group of teachers). These types of support have been called pedagogies of enactment (Grossman et al., 2009a) because of the opportunities to perform or act out aspects of practice in increasingly complex settings.

The specification of the various forms of facilitator expertise oriented the delineation of goals for the learning of the three coaches who participated in the study. The various types of supports oriented the design of the professional development for the three coaches in this study. Thus in this section, I outlined conjectures about *what* PD facilitators might need to know and be able to do to provide HQPD and about *how* to support them in developing this expertise. In the next chapter, I outline an approach for investigating these conjectures given their provisional status, in the process specifying the methodology for my dissertation study.

CHAPTER III

OVERVIEW OF RESEARCH DESIGN AND METHODS

This dissertation study is a part of a larger research project that seeks to understand what it takes to support instructional improvement of middle-grades mathematics at scale through work with large urban districts in the U.S. (Middle-School Mathematics and the Institutional Setting of Teaching, MIST). In the focal district, which I will call District B, very few teachers had developed ambitious and equitable teaching practices in spite of the extensive support provided by district leaders. These supports included, among other things, the adoption of an ambitious curriculum organized around rigorous mathematical activities, the hiring of school-level coaches, and the provision of content-specific PD for coaches, principals, and teachers.

Late in the 2011-2012 school year, District B leaders hired three district-based mathematics coaches to work with mathematics teachers across approximately 30 middle schools as a means for supporting instructional improvement. As part of their work, these coaches were charged with planning and leading PD for the mathematics teachers in the district. There are indications that all three coaches were accomplished mathematics teachers. For example, interviews conducted with the coaches indicated that they had sophisticated visions of high-quality mathematics instruction (Munter, 2014) and, based on scores of the Learning Mathematics for Teaching (LMT) assessment tool, they also had better than average mathematical knowledge for teaching (Hill, Ball, & Schilling, 2008). Also, based on scores on the Instructional Quality Assessment (IQA; Boston & Wolfe, 2006), the two coaches for whom we had instructional videos exhibited slightly more sophisticated instructional practices than

most teachers in their district. That is, their instructional practices were consistent both with the district's instructional vision and with CMP2. In addition, all three coaches had worked as school-based coaches in district B prior to being hired as district-based coaches.

Despite indications that these three coaches were accomplished mathematics teachers, there were indications that they needed help in developing ways of supporting groups of teachers in reorganizing their teaching practices. Specifically, after viewing PD led by these district coaches, our assessment of their initial practices suggested that they would need significant support in designing and leading HQPD. In the following section, I briefly describe the coaches' initial practices.

Coaches' Initial Practices

In the summer of 2012, as part of MIST data collection, we video-recorded a set of PD sessions that the coaches led. One of the coaches, Alice[1] led a two and a half hour session for seventh grade teachers on planning for an instructional unit that would last several weeks. The other two coaches, Amanda and Malcolm, co-led a two and a half hour session for grades 6–8 teachers on formative assessment. Members of the MIST project research team (which included two Principal Investigators (PIs), three other research assistants, and myself) viewed these videos and created memos in which we noted the coaches' PD designing and PD facilitation practices prior to our collaborative work with them. We also analyzed these videos to identify goals for our work with the coaches and to inform the design of our collaborative work and the supports we planned to provide for the coaches.

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[1] Names of participants are pseudonyms

For the purpose of my dissertation analysis, I re-watched these videos to take more detailed notes of the coaches' initial practices. I describe my method for analyzing video of PD sessions later in this chapter (in the "method of analysis" section).

Our assessment of the coaches' initial facilitation practices indicated that they needed help in developing ways of supporting groups of teachers in reorganizing their teaching practices. Specifically, the PD activities the coaches had designed were unlikely to support teachers' development of instructional practices compatible with the district's instructional vision. For example, both PD sessions involved providing teachers with activities to use in their classrooms (e.g., games to play with students in order to review for an upcoming test) or addressing issues and adjusting practices that are not central to mathematics instruction (e.g., creating and using word walls). Against the background of research on high-quality professional development, there was little indication that these activities or the ways teachers were asked to engage in these activities had the potential to support teachers in developing more ambitious teaching practices.

In both sessions, it was also difficult to infer clear learning goals for the session from the activities that the coaches enacted with teachers. For instance, in the PD session on formative assessments, the two facilitating coaches (Amanda and Malcolm) led a number of different activities that were not clearly connected. Specifically, they spent 43 minutes clarifying the distinction between formative and summative assessments, then 25 minutes demonstrating how to introduce a lesson productively, then 34 minutes on giving students meaningful written feedback, then 21 minutes having teachers generate examples of different assessment techniques including the pros and cons of each, and finally 10 minutes demonstrating how to use a website to poll students as a means of quickly checking for understanding. From our observations of the

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different activities the coaches facilitated, each activity had potential to support very different learning goals for the participating teachers.

The coaches also designed and enacted activities that reflected an assumption that the purpose of PD is to find and correct deficits in teachers' current practices. For example, in the session on formative assessments, Amanda and Malcolm had teachers label and sort various types of assessments and different purposes for assessing as being either formative, summative, or both. The coaches then provided definitions of formative and summative assessments before prompting the teachers to think back and decide whether they thought they had correctly classified the purposes and types of assessments. In the enactment of this activity, there were correct and incorrect labels for the purposes and types of assessments and the definitions were provided as a way to help "clarify" the distinction between formative and summative assessments for teachers and to help the teachers in correctly classifying assessments in the future.

The coaches designed and enacted activities that framed instructional practices abstractly and obscured key aspects of specific practices. For example, in the PD session focused on planning for upcoming instruction, the coach that facilitated the PD (Alice) told teachers to work in groups to co-plan an entire unit. Though the coaches provided the unit materials and encouraged teachers to use them, teachers were not prompted to solve any of the mathematical tasks in the unit and were not pressed to articulate goals for student learning. Solving the tasks and outlining the goals for student learning are two key aspects of lesson planning and yet they were omitted from this PD on planning for instruction. Furthermore, the types of planning activities we observed were not rooted in concrete or shared experiences or even in a specific

lesson. As a consequence, discussions of instruction were relatively abstract and could at best only support teachers in adjusting already well-established practices.

In addition, though the coaches demonstrated that they did know how to elicit teacher responses, their facilitation in these videos indicated that they needed support in developing meaningful ways of building on and connecting teachers' contributions. For example, in both sessions, they often asked teachers to share their ideas, but consistently did not press teachers to elaborate on the ideas they shared, check that other teachers understood what was shared, or make connections between the contributions.

The underlying assumptions reflected in the activities the coaches designed and enacted with teachers, the lack of clarity in terms of how the activities were to support teachers in making progress towards specific goals or the development of particular practices, and the absence of press on teacher ideas indicated that these coaches needed help in developing ways of supporting groups of teachers. This is particularly true considering that the aim of these teacher PD sessions was to support teachers in drastically reorganizing their practice. In the following section, I describe the long-term goals for our work with the coaches that we identified based on this assessment of their initial practices.

Goals for the Coaches' Learning

Members of the MIST research project team and district B leaders (the Director of Curriculum and Instruction and the three Secondary Mathematics Directors/Learning Network Directors) agreed to collaborate on supporting the three new district coaches' learning during the 2012-2013 academic year. Based on our assessment of the coaches' initial PD planning and facilitation practices and in light of the literature on the development of complex practice, we

identified three goals for the coaches' learning: 1) to view and approach supporting professional learning as a trajectory or progression, rather than a "filling in" of deficits; 2) to design supports for teachers' learning that are informed by assessments of teachers' current practices, are oriented towards long-term goals for teachers' learning, and constitute reasonable next steps in the teachers' development; and 3) to facilitate professional learning activities by pressing selectively on the participating teachers' ideas and building on their contributions. Against the background of research on HQPD, there is indication that these are sound goals for coaches' learning given that the ultimate aim is to support the three coaches in developing the capacity to design and lead HQPD.

Goal One: Viewing Professional Learning as a Trajectory

Sherin (2001) introduced Charles Goodwin's (1994) concept of professional vision to teacher education by suggesting that part of developing sophisticated instructional practices involves developing a professional vision of instruction. Building on Sherin's work, we identified developing a vision for professional learning as a goal for our work with the coaches. Namely, we aimed to support them in viewing their work as PD facilitators and supporting teacher' learning as a progression, rather than as fixing or correcting deficits in teachers' practices. Thus the first goal of supporting the coaches in viewing and approaching professional learning as a trajectory rather than filling in gaps or rectifying deficits was appropriate. It is important to note that in identifying this goal we view professional vision as a particular way of seeing and understanding and not simply a cognitive ability for which *differences* (that could be the result of differences in values, roles, task requirements, and other conditions) can be recast as *deficits* (Lefstein & Snell, 2011).

Literature on HQPD also indicates that viewing PD as a means of supporting teachers in developing increasingly sophisticated practices is key to the work of designing PD and other supports for teachers (Borko et al., 2010; Gibbons, 2012; Wilson & Berne, 1999) and that this work and these supports need to be sustained over time (Jackson & Cobb, 2012). This is because supporting HQPD facilitators in developing a vision of teachers' learning as a progression is crucial given that the goals for teachers' learning in HQPD requires a significant reorganization of the teachers' current practices. For example, supporting teachers in shifting from facilitating "show-and-tell" discussions to facilitating discussions in which the teachers press students to explain their reasoning and build on student contributions is difficult and it is not reasonable to expect teachers to make such a shift after simply being told to do so. Moreover, viewing supports for teachers' learning as correcting deficits often leads to treating PD as a one-time handoff of information or ideas. Thus in identifying goals for our work with the coaches, we agree with Stein, Smith, and Silver's (1999) argument that "professional developers' decisions and actions are rooted in their knowledge and beliefs about how to effect change and their theories of how teachers learn" (p. 264). Our work towards this goal was designed to support the coaches in developing more sophisticated views of teachers' learning.

Goal Two: Designing Supports for Teachers' Learning that are Informed by Assessments of Their Current Practices

The second goal for our work with the coaches was that they would design supports for teachers' learning that were informed by assessments of teachers' current practices and were oriented towards long-term goals for teachers' learning but constitute reasonable next steps in supporting teachers in reaching these goals. This goal is also fitting because literature on HQPD

suggests that PD facilitators need to be able to establish clear and productive goals for the teachers' learning and to select and facilitate appropriate activities for supporting teachers in attaining these goals based on their assessments of the participating teachers' current practices (Ball et al., 2009; Grossman et al., 2009a; Schifter & Lester, 2005). Again, given the goals for teachers' learning (e.g. developing more ambitious instructional practices with a focus on the practices involved in facilitating whole class discussions) and the complex work involved in supporting teachers in reaching these goals, it is essential that the coaches work towards designing supports that required them to make ongoing assessments of teachers' practices and adjust the supports offered in response to their assessments.

It is important to note that this second goal is related to the first goal of developing views of instructional improvement as a developmental trajectory rather than as rectifying deficits because viewing the work of supporting teachers' learning as correcting deficits, would lead to framing assessments of teachers' current practices in terms of whether or not they "got it" (i.e. either the teachers learned what was taught or they did not). This framing would not support the coaches in thinking about what their PD is designed to support teachers to learn nor would it help them in making adjustments to their designs to better support teachers in making progress towards the identified goals for teachers' learning. In addition, supporting the coaches in developing views of teacher learning as a trajectory also supports them in thinking about how teachers need to change their practice while making ongoing assessments of teachers' current practices. In other words, part of the work of assessing teachers' current practices is thinking through the next steps along the "hypothetical learning trajectory" (Simon, 1995) and how they as coaches can design PD that supports teachers in making these next steps.

Goal Three: Pressing on Teacher Ideas Differentially and Building on Their Contributions

The third goal was that the coaches would facilitate PD by pressing on teachers' ideas and building on teacher contributions (Elliot et al., 2009). This is an appropriate goal in light of the literature on HQPD that suggests that facilitators need to be able to orchestrate productive discussions (Borko et al., 2014; Elliot et al., 2009; Schifter & Lester, 2005), adequately press on teacher ideas, and build on teacher contributions (Cobb et al., 1990; Fennema et al., 1996; Grossman et al., 2013; Schifter & Fosnot, 1993). Considering the ambitious goals for teachers' learning, pressing on teachers' current conceptions of issues related to mathematics instruction is a necessary first step in supporting teachers in reorganizing their current practices.

Part of the work of making ongoing assessments of teachers' current practices involves viewing PD in terms of supporting teachers along a learning trajectory and identifying long-term goals as well as next steps in supporting teachers in reaching these goals. Since productively pressing on teacher ideas requires that the coaches have clear goals for teacher learning, this goal of pressing differentially relates to the first two goals for our work with the coaches.

Conjectured Design for Supporting the Coaches' Learning

These three related goals are ambitious and require significant support. Specifically, since the intended goals for teacher learning require significant reorganization of teachers' current practices, it seemed important that the coaches come to view and approach supporting teachers' learning as a long-term developmental progression. The coaches' development of this perspective on teachers' learning involves a significant reorganization of their current practices. The literature on HQPD indicates that reasonable supports for coaches in reorganizing their current practices include opportunities to analyze their current practices, reflect on and discuss

aspects of their practice that may be problematic, and develop more sophisticated practices with the support of more expert others (Grossman et al., 2009a; Kazemi et al., 2009). Thus the conjectured supports for the coaches included ongoing opportunities to investigate PD planning and facilitation practices by watching and discussing video-recordings of themselves enacting facilitation practices with members of the research team and district leaders.

The coaches needed to *continually* assess teachers' practices if they were to design adequate supports and modify those supports as teachers make (or do not make) progress. The literature on HQPD indicates that supporting coaches in developing the skills and knowledge necessary to assess teachers' developing practices and adjust their plans for PD accordingly involves providing opportunities for the coaches to analyze and reflect on representations of teacher PD and develop plans for re-designing PD based on their reflections and analyses (Grossman et al., 2009a). Thus the conjectured supports for the coaches included opportunities to investigate video recordings of themselves leading PD followed by opportunities to reflect and redesign the PD based on what they observed.

Lastly, given that teachers' development of ambitious teaching practices requires a significant reorganization of their current practices, it was important that the coaches press on teachers' current conceptions of teaching. Pressing productively requires the coaches to have clear goals for teachers' learning and to consider these goals while strategically deciding on which ideas to build and which ideas to let go. Pressing proficiently also requires the development of a number of complex talk moves (e.g., revoicing and probing for further explanation following teacher contributions) which cannot be developed by simply watching or being told to do it. The literature on HQPD indicates that supporting coaches in developing the ability to press on teachers in these ways involves providing opportunities for the coaches to plan

and tryout the performative aspects of the pressing on teacher ideas while appropriately adjusting the challenge involved (Kazemi et al., 2009). Thus, the conjectured supports for the coaches included ongoing opportunities to plan to facilitate teacher discussions during PD as well as opportunities to watch and reflect on videos of themselves facilitating these discussions with members of the research team and district leaders.

Against the background of research on HQPD, there are indications that these conjectured supports are reasonable and are sound. In the following sections, I discuss our design of supports to help the coaches achieve these goals.

Design of the Study

Given the thin research base on supporting the development of sophisticated PD facilitator practices and the tentative and highly revisable nature of the conjectures about the process of learning for PD facilitators and the means of supporting it, it was reasonable to conduct a design study in order to investigate these conjectures. Against the background of research on supporting the development of complex practices, it is also important to incorporate ongoing assessments of PD facilitators' developing practices and capabilities, and modify the design and revise the underlying conjectures based on these assessments. We therefore approached the work of supporting the district's three mathematics coaches as a professional development design study.

Design studies generally have two emphases: (1) pragmatically investigating and improving a design for supporting learning, in this case for coaches or PD facilitators, and (2) theoretically developing, testing, and revising conjectures about learning processes for coaches or PD facilitators as well as the means of supporting this learning. The resulting analysis

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represents the basis for the design (Brown, 1992; Cobb, Jackson, & Dunlap, 2014; Collins, 1992; Collins, Joseph, Bielaczyc, 2004).

Cobb, Confrey, diSessa, Lehrer, and Schauble (2003) identified five cross-cutting features that apply to design experiments. The first feature is that the purpose is to develop theories about both the process of learning and the means that are designed to support that learning. This professional development design study involved developing and refining a design for supporting PD facilitators (in this case the three mathematics coaches) in developing more productive practices for designing and leading PD while also developing, testing and revising conjectures about both the process of learning to design and lead HQPD and the means for supporting this learning. Thus, the goal of this professional development design study was to contribute to the development of a practice-specific professional development theory that delineates a learning process for facilitators' development of more sophisticated PD planning and implementation practices while simultaneously demonstrating the means of supporting this learning process.

The second feature is the interventionist nature of the design experiment methodology. Related to the second feature is the third feature: that design experiments create conditions for developing theories that must be put in harm's way. In other words design experiments have both prospective and reflective aspects (Cobb et al., 2003). In this design study, on the prospective side, we planned and enacted a design for supporting the coaches' PD facilitation practices that was based on hypotheses and literature on HQPD and supporting the development of complex practices. At the same time, on the reflective side, we intervened and generated and tested alternative conjectures when necessary. We also kept in mind that the evaluation of the design

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was an ongoing process that could change as the design changed (Collins, Joseph, Bielaczyc, 2004).

The fourth aspect is the iterative design (Cobb et al., 2003). In this design study, the research team conducted four iterative cycles of design and analysis, and made adjustments to the work with the coaches from one cycle to the next (e.g., the focus and goals for each session, the activities enacted with the coaches, the questions asked, and the ideas on which the coaches were pressed were adjusted). Each cycle comprised of four phases (see Figure 1). First, members of the research team planned and led a PD session for the coaches (the research team planned and led the three coach PD sessions. As part of a planned handover of responsibility, the Director of Secondary Mathematics for the district (henceforth, the Director) planned and led a fourth coach PD session. Only the sessions planned and led by the research team are included in this analysis. In addition to the coaches and members of the research team, the Director and the district's two middle-grades mathematics Curriculum Specialists (henceforth, the Specialists), who were responsible for developing the district's curriculum frameworks, participated in the Coach PD sessions. Thus, the research team members provided expertise on designing and leading professional development, and the Director and the Specialists provided expertise regarding the curriculum, development of key mathematical ideas within and across grade levels, and teachers' current practices.
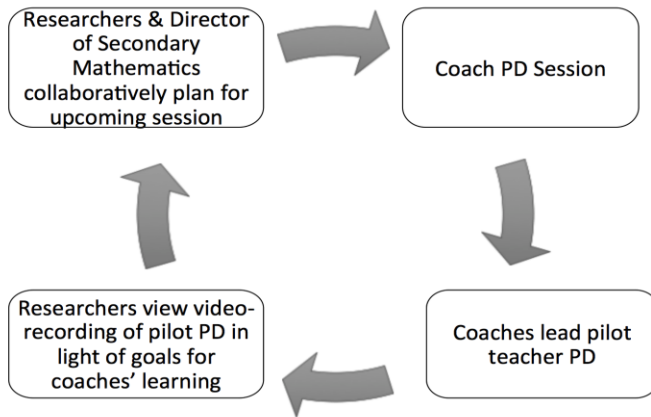
Figure 1: Iterative cycle of design and analysis aimed at supporting coaches' learning

The coach PD sessions, which were typically five hours long, focused on planning and leading an upcoming pilot teacher PD session that was organized around a specific 6th or 7th grade CMP2 lesson or unit. The focal 6th or 7th grade CMP2 lesson/unit was selected by the Director and Specialists as one that was known to be difficult for teachers to teach. Note that although the pilot teacher PD was organized around a focal lesson/unit, the intention was to support the coaches in designing PD activities that could potentially support teachers in developing more sophisticated instructional practices in general. The focal lesson/unit was a way to ground the work coaches did with teachers, and the work that we did with the coaches. The focal lesson that was selected alternated between 6th and 7th grade, with the coaches leading two sessions for 6th grade teachers and one for 7th grade teachers.

In the coach PD sessions, the coaches engaged in various activities that involved engaging in pedagogies of investigation and enactment with more accomplished others. For example, in all but the first coach PD session, we analyzed two to three brief video-clips (each clip was about three minutes in length) of the coaches facilitating the prior pilot teacher PD session (which they had planned in the previous coach PD session). The video clips were chosen

by members of the research team who watched the prior pilot teacher PD session and selected the segments to reflect aspects of the coaches' PD facilitation that had improved and areas for future improvement. During the coach PD, we specifically asked the coaches questions and facilitated discussions about what they observed in the clips, reflected on things done well and on aspects of their practice that appeared to be problematic, thus engaging in pedagogies of investigation.

We also co-planned the upcoming pilot teacher PD session, which involved working through the focal CMP2 lesson, discussing teachers' current practices based on the coaches', Director's, and Specialists' classroom observations, identifying goals for teachers' learning in light of the focal lesson and teachers' current practices, designing PD activities to achieve those goals, and identifying 2-3 ideas on which to press teachers when enacting the activities. For example, we shared our finding that teachers in this district did not typically incorporate whole-class discussions into their daily lessons and those that did facilitated "show-and-tell" discussions. The goals for teachers learning that emerged in the subsequent discussion included recognizing the importance of whole class discussions and pressing students to explain their reasoning and to connect their ideas to others' ideas. We then designed lesson-modeling activities in which the coaches would first enact a show-and-tell discussion and then a genuine whole-class discussion, before facilitating a reflection in which teachers compared their experiences as learners in both. This type of co-planning served as a means for providing opportunities for the coaches to engage in pedagogies of enactment, specifically enacting PD planning practices, while also providing opportunities to co-participate with more accomplished others (namely the facilitators of the coach PD). In addition to supporting teachers' improvement of concluding whole-class discussions, the goals for teachers' learning included improving teachers' understanding of the logic of a CMP2 lesson.

Since the pilot teacher PD was always organized around specific lessons, part of our work with the coaches involved collaboratively developing a generalizable routine for planning upcoming lessons that the coaches could work through with teachers. We worked through this routine in each coach PD session by first solving the mathematics tasks, identifying the key mathematical learning goals for students, and determining how these goals fit in a sequence of lessons (Elliot et al., 2009). We shared common student misconceptions that could come up during the lesson and also identified key solutions that would be important to highlight during the whole class discussion as well as a few questions that the teacher might ask. We also discussed what would need to be developed in earlier phases of the lesson for the whole-class discussion to be productive and considered ways to support struggling students. The next step after working through the planning routine was to plan specific activities that the coaches would implement during the upcoming teacher PD. As our time with the coaches was limited, they met after the coach PD sessions to finish their planning.

Collaboratively developing this lesson planning routine was a primary way in which we provided opportunities for the coaches to co-participate with more accomplished others while enacting PD facilitator practices, in this case practicing facilitating collaborative lesson planning. Developing this routine together also supported the coaches in anticipating what they needed to think through about the focal lesson prior to planning pilot teacher PD sessions.

In the second phase of the cycle, the coaches led the pilot teacher PD with a group of teachers. Each of the pilot teacher PD sessions was led solely by the coaches and video-taped for future viewing by the research team. The teacher PD sessions generally lasted three hours, were held in the evenings after school, and had on average 25 sixth or seventh grade teachers in attendance. The teacher PD sessions were voluntary for teachers and the district provided a

stipend to attract teachers who might be interested in engaging in the work. The district Director also attended in order to assess the quality of the sessions. Leading the Teacher PD sessions provided the coaches with opportunities to try out their developing PD facilitation practices in a setting of reduced complexity where they could get feedback from more accomplished others.

All but one of the pilot teacher PD sessions were deliberately organized around planning for and implementing an upcoming CMP2 lesson (the third pilot teacher PD session was organized around an entire CMP2 investigation/unit opposed to a single lesson). In each of the pilot teacher PD sessions, the coaches modeled instructional practices. For example, they modeled different ways of facilitating whole-class discussions and facilitated discussions by prompting the teachers to reflect on these instructional moves and on their own experiences as "the students". In addition to these facilitated discussions, each teacher PD session included discussions of the goals for students' learning in the focal lesson/unit and the purpose of the different phases of the lesson in light of these student goals. These facilitated discussions provided opportunities for the coaches to approximate the targeted practices of pressing and building on teachers' ideas differentially.

In the third phase of each cycle, members of the research team viewed video-recordings of the pilot teacher PD to gauge developments in the coaches' practices and to select facilitation video-clips to be analyzed in the next Coach PD session. For each video viewing, we made running notes that included observations about the structure of the session (e.g., what activities were conducted, how long each activity took, and who led the activities). We also made time-stamped observations about, among other things, the coaches' choices that we felt needed to be explained (e.g., why they decided to ask certain questions at certain times and what were the goals of doing particular activities with the teachers), the nature of teachers' participation (e.g.,

teachers seem to be fully engaged in considering whether it would be productive to support struggling students by changing the numbers in a task), what could be inferred about the coaches' goals for teachers' learning from their enactment of each activity, moments where we saw productive facilitator moves (e.g., pressing on teacher contributions), as well as evidence of practices that needed further improvement, and other observations specific to the goals for coaches' learning. We then met to discuss our top-level observations and created a memo based on this discussion framed around the feedback we wanted to give to the coaches specific to the goals for their learning and the illustrative clips we planned to use in the following coach PD session.

In the fourth phase, members of the research team and the Director collaboratively reexamined goals for coaches learning and planned for upcoming Coach PD sessions. We debriefed the pilot teacher PD session with the Director, who had attended the sessions in person, by asking for her top-level observations and also shared our observations. Informed by these observations, we then formulated goals for the upcoming Coach PD session and selected 2-3 clips to watch with the coaches (at least one of which represented an improvement in practice and at least one represented an area on which to focus attention in the upcoming session). These debriefing conversations were conducted via conference calls and were followed up with a brief face-to-face meeting before the following coach PD session. This four-phase cycle was enacted with the research team's involvement three times in fall 2012 and the duration of each cycle was about a month (cycle 1- October, cycle 2- November, cycle 3- mid December to mid-January). The coaches and the Director enacted the cycle an additional time in spring 2013 (in February). Again, for the purposes of this analysis, I only focus on the first three cycles as the research team was not actively involved in the design or enactment of the additional cycle.

My role in this work was to contribute to planning and designing the coach PD sessions. I also attended two of the coach PD sessions to help facilitate, take field notes, video-record, and give on the spot feedback to the other coach PD facilitators. In addition, I led viewings of the video recordings of pilot teacher PD, co-wrote memos about what was observed, and provided feedback and suggested next steps to the leaders of the coach PD sessions and the coaches themselves based on these observations.

The fifth characteristic of design experiments is that theories developed during the process are concerned with domain-specific learning processes and are accountable to the activity of the design (Cobb et al., 2003). In other words, the theories developed must do real work or produce "useable knowledge" (Kelly, 2004) and inform prospective designs. The intent of this design experiment is to not only add to developing theories on the learning processes for facilitators' development of more sophisticated PD planning and implementation practices and the means of supporting this learning but to also directly inform future iterations of similar work with mathematics instructional coaches being supported to design and enact PD with teachers around upcoming lessons.

Data and Method of Analysis

My dissertation investigates what developing facilitator expertise looks like and how to design supports for this learning process. Therefore, I analyzed the data we collected in the cycles described above in a way that enabled me to assess *the extent to which* the coaches learned and developed facilitator expertise, to specify *what* they learned, and to document *how* their learning was supported. Before discussing what the facilitator learning process entailed and/or how our design supported this learning, I first need to establish that learning occurred. I

also need to specify what it is that was learned. In addition, because the design of each session

was influenced by our ongoing assessment of the coaches' learning, understanding what they

learned from each session as well as how we made adjustments to our work with the coaches

between sessions is a significant part of understanding how the design supported their learning

and constitutes the rationale for proposing revisions to the enacted supports that can inform

future work. Thus, it is also important to attend to our learning as a research team. In the

following sections I describe the data collected and give a brief explanation of how I used and

analyzed the collected data.

Data Collection

The data collected to document whether and what the coaches learned as well as the

process of this learning include 1) video recordings of coaches leading teacher PD before we

started working with them, 2) video recordings of the coach PD sessions in which the coaches

planned an upcoming teacher PD session, 3) video recordings of coaches leading the pilot

teacher PD session, 4) artifacts and products generated and collected during pilot teacher PD

sessions, and 5) audio-recorded interviews conducted with the coaches. We annually interview

all participants in the larger project in January. These interviews generally focus on the district's

plans for improving mathematics instruction. During the year in which we worked with the

coaches, we asked them about, among other things, their visions of high-quality instruction and

high-quality PD as well as their perceptions of the PD in which they participated.

The data collected to document the coaches' learning and the supports for that learning

include: 1) planning materials (e.g., detailed agendas that list top-level goals, activities, and

pacing suggestions), 2) video-recording of coach PD sessions, 3) field notes and memos taken

during coach PD sessions, 4) analytic memos prepared after viewing video-recordings of pilot

teacher PD sessions led by coaches, and 5) artifacts and products generated and collected during

coach PD sessions. These data were also collected to document the learning of the research team

and the adjustments made to the design after each session. This issue is significant as it will

inform my proposed revisions to the design. In the following paragraphs I discuss these data in

more detail.

As described in the "Coaches' Initial Practices" section of this chapter, video recordings

of each of the three coaches leading a teacher PD session were collected at least once during the

three months prior to our first session with them. These video recordings enabled me to

document how the coaches worked with teachers and get "baseline" readings of the coaches PD

facilitation practices (e.g., the extent to which they provided opportunities for teachers to actively

participate, to talk about aspects of teaching that are close to instructional practices, and to share

or reflect on their experiences and the extent to which teachers were pressed to support claims

made and to explain their reasoning). In addition, we collected copies and took pictures of both

the artifacts used during the teacher PD sessions and the participants' written products (e.g.,

pages from the curriculum and teacher's manual, copies of curriculum frameworks and pacing

guides, as well as examples the work that teachers produced during the PD sessions, such as

posters displaying their strategies for solving tasks in the focal lesson). These artifacts helped me

both document the work accomplished in these sessions and assess the extent to which the tools

used and activities conducted during the sessions were likely to support teachers in developing

ambitious instructional practices.

The three coach PD sessions were video-recorded. These video recordings enabled me to

describe the work that the research team did with the coaches and helped me in documenting the

coaches' PD planning practices (e.g., the extent to which they developed and incorporated PD planning routines and the extent to which they made adjustments to their plans for PD based on what they observed in previous work with teachers). These videos also enabled me to assess the extent to which the coaches were making progress on the overall goals for our work with the coaches as well as more immediate session goals. We recorded the issues addressed when preparing for the coach PD sessions (i.e. we saved planning materials such as running notes of the questions addressed, detailed agendas created by the research team that list top-level and immediate session goals, activities and pacing suggestions, as well as talking points to be covered during the PD). We made copies and took pictures of artifacts used during the coach PD sessions and of the coaches' written products. These artifacts helped me in documenting the work done in these sessions and in assessing the extent to which the tools used and activities done during these sessions were likely to support coaches in developing more sophisticated PD planning and facilitation practices. Finally, in addition to artifacts generated during the coach PD sessions, we collected additional planning materials that the coaches created in preparation for the pilot teacher PD after the coach PD session. These materials document the coaches' PD planning practices and supplemented the data collected from the coach PD sessions by providing evidence of coach planning and preparation that occurred outside of the coach PD sessions.

I wrote field notes during the coach PD sessions, and I and other members of the research team prepared analytic memos after viewing recordings of the coach PD sessions. These notes and memos supplemented the video recordings and enabled me to better document our ongoing assessments of the coaches' development as well as the adjustments we made in response to these assessments.

Video recordings of the pilot teacher PD sessions led by the coaches were collected for each of the iterative cycles. These video recordings documented the coaches PD facilitation practices and recorded changes in their practices (e.g., to what extent did the coaches provide more opportunities for teachers to make contributions and give rationales for the claims made). These video recordings also helped me to identify evidence that coaches were making progress on both the overall and immediate goals for our work with them. We also collected copies and took pictures of artifacts used during the PD sessions and participants' written products. These artifacts helped me in documenting the work done in these sessions and in assessing the extent to which the tools used and activities done during these sessions were likely to support teachers in developing ambitious instructional practices.

I and the other team members prepared analytic memos after viewing recordings of the pilot teacher PD sessions. These memos include a record of our ongoing observations together with suggestions for future sessions. They supplemented the video recordings and helped me in documenting both our ongoing assessments of the coaches' development and our rationales for the adjustments made to our design in response to these assessments.

Audio recordings of interviews with each of the three coaches were collected, as part of our annual data collection for the larger project, before and during our work with them. We also interviewed the three coaches in January 2014 (about a year after the last of the three iterative cycles). During these 45-60 minute audio-recorded interviews, the coaches were asked about their visions of high-quality mathematics instruction. They were also asked about the work they were doing as coaches (i.e. their role in leading PD and other the activities in which they engage with and support teachers). For example, they were asked about modeling lessons, facilitating teacher collaborative work groups, and co-planning with individual teachers. In addition, they

were asked about their views of high-quality professional development. For example, we asked about what HQPD entails, how to plan for it, and their role in facilitating it, as well as their goals for supporting teachers' learning during HQPD. Finally we asked about the district supports provided to prepare and help them in their work as coaches.

These interviews enabled me to gauge their perspectives on their work with the research team during the 2012-2013 academic year including the extent to which they found it useful and whether and how they have incorporated it into their work with teachers. These interviews also enabled me to assess their vision of instruction and their views of HQPD, and to document the extent which these have changed over time.

Data Analysis

My analysis focused on the coaches' PD planning and implementation practices. Specifically I examined what the coaches learned in each session of coach PD and describe how the PD supported this learning. On the basis of this analysis, I then propose how to revise or improve on this design to better support PD facilitators' development. I outline these proposed revisions in the discussion chapter.

Analyzing "what" the PD facilitators learned. In order to understand what the coaches learned from each session, I constructed coding schemes and then coded the video recordings of both the coach and pilot teacher PD sessions in NVIVO (a commercial software package used for qualitative analysis). I developed two sets of codes: one for examining the coach PD sessions and another for the pilot teacher PD sessions. My analysis focused on what the coaches were doing and saying (i.e. the talk and/or action) that demonstrated their development of more sophisticated PD facilitation practices.

To examine what the coaches learned about PD planning, I constructed coding schemes and coded the video recordings of the coach PD sessions. Specifically, I coded for the development of planning routines (e.g., how many times, how effectively, and how long did the coaches spend examining, assessing, and discussing teachers' current practices; identifying clear and productive goals for teacher learning based on their current practices; designing appropriate activities to support teachers in achieving these goals; identifying key ideas to press on while facilitating discussions during PD; and rehearsing questions to be used to press teachers with one another). Since the planning routine was to be jointly enacted by members of the research team and the coaches in the PD sessions, additionally, I coded for how many times, how effectively, and how long the coaches spent enacting aspects of this routine independently at least in the PD sessions (i.e. examining whether they appear to have been adequately supported in taking up or enacting this routine for themselves). I took into account the research team's role in initiating and guiding the enactment of the routine and attended to the extent to which our initiations and guidance decreased across sessions as well as the extent to which the coaches came to initiate the enactment of aspects of the routine on their own.

I also attended to the extent to which there was evidence of progress on the immediate session goals (outlined in our planning documents) as well as the overall goals for our work with the coaches. For example, I looked for evidence that the coaches made contributions during the coach PD sessions that demonstrated that they were developing views of their role as PD leaders that emphasized supporting teachers' development of improved instructional practices, rather than identifying and attempting to "fix" deficits in current teacher practices.

I also coded the coaches' rationales for specific teacher PD activities and for asking certain questions. For instance, I assessed the activities and questions that coaches planned for

their potential to support or scaffold teachers in achieving the learning goals set by the coaches (i.e. how well their plans set them up for achieving their goals in light of literature on HQPD). I compared these codes across the coach PD sessions to see whether their goals for teacher learning and the plans they developed for teacher PD become more closely aligned. Specifically, I determined whether the coaches planned more appropriate activities for teacher PD considering their goals for teacher learning over time. For instance, I examined the extent to which there was a direct connection between what teachers were asked to do and what they are being supported to learn. In addition I reviewed the planning materials the coaches produced to further document the extent to which the planning routine became a personal routine appropriated by the coaches. Finally, I analyzed interview data to assess the extent to which the ways the coaches report about how they plan and prepare for PD changed over time.

To examine what the coaches learned about facilitating PD, I constructed coding schemes and coded the video recordings of the coach-led teacher PD (the "baseline" sessions and the pilot teacher PD sessions). In particular, I coded for the potential of the activities to support teachers' instructional improvement (e.g., the extent to which the activities focus on key instructional practices, support teachers in problematizing their current practices, provide opportunities for active and collaborative teacher participation, and provide opportunities to rehearse and develop more sophisticated practices). I also attended to the extent to which there was evidence of progress on the immediate session goals and the overall goals for our work with the coaches. For example, I assessed the extent to which the coaches pressed on teachers' ideas differentially during the pilot teacher PD sessions. In addition, I coded for the development of interactional and enactment routines for PD facilitation (e.g., the extent to which coaches pressed on participating teachers' ideas and whether this press was in service of the identified goals for

teachers' learning, as well as the extent to which the coaches encouraged teachers to share problems of their practice, provide justifications for claims made, and build on and challenge each others' ideas). I compared these codes across the teacher PD sessions to examine changes in the ways the coaches lead teacher PD. Finally, I analyzed interview data to assess the extent to which the ways the coaches reported about implementing PD and their role as facilitators of PD changed over time.

Analyzing "how" the PD facilitators learned. In order to understand whether and how the PD we designed supported the coaches learning (i.e. to document the learning process and the supports for this learning), I first coded the video data of the coach PD sessions. My analysis focused on what the coaches were doing, saying, and being asked to do (i.e. the talk and/or action) that appear to support their development of more sophisticated PD facilitation practices. My codes were based on extant research on supporting the development of complex practices. For example, the research literature indicates that rehearsals are an important aspect of supporting the development of complex practices (Kazemi et al., 2009; Lampert et al., 2013). Thus, I attended to the provision, frequency, and richness of opportunities to rehearse the complex practices that the coaches were being supported in developing by capturing or marking instances of rehearsals in NVIVO and by assessing how close of an approximation to actual practice each rehearsal offered (e.g., were the coaches asked to briefly respond to a hypothetical situation or did they participate in a role playing exercise).

My codes were also based on what emerged as important to the work of supporting complex practices in observing our attempts to support the coaches. For instance, consistently pressing the coaches for explanations of their current practices and constantly asking them to justify facilitator moves depicted in the pilot teacher PD videos emerged as an important aspect

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of our work in supporting these coaches' development of facilitator expertise. Thus, I attended to the issues on which the coaches were and were not pressed to provide justifications by capturing instances of this type of press in NVIVO. It is worth noting that the codes developed for this analysis might potentially be used for investigating the quality of supports provided through PD in other contexts and in future research.

I then completed summaries of each session based on the codes, field notes, and memos written for the respective sessions (e.g., summaries may include frequencies of the above mentioned codes and other top-level descriptions of the sessions). I prepared a summative analytic memo tracking coaches learning (changes in planning and facilitating practices) across the sessions.

Documenting changes in our practices as a research team was vital because it informed my proposed revisions to the design of work with PD facilitators. Thus, to investigate ways to improve the design of the supports, I first reviewed the planning materials that we developed to prepare for the coach PD sessions, matched the goals for the coaches' learning with the activities we planned to enact with the coaches that were designed to support the coaches in achieving these goals, and created a memo that kept track of these relations across the sessions. I also prepared analytic memos to track changes in aspects of the design of the coach PD across the sessions. For example, I examined the selection of activities/planning of the sessions, the facilitation of the sessions, the participation of others during the sessions, the mathematical content discussed in each session, and the details about the pilot PD that the sessions were designed to support coaches in planning and leading and looked for how these changed from cycle to cycle. To do this, I reviewed the planning materials alongside the field notes and memos then summarized differences between the intended and the enacted plans for coach PD and kept

track of notes about the extent to which there were unforeseen challenges of facilitation that played a role in these differences. I then compared these memos and examined the extent to which the design of the sessions could account for changes in coaches' facilitation practices and developed process-oriented explanations. I then wrote and reviewed a memo that summarized the relationship between the coach PD and the coaches' learning and made note of the extent to which the goals for coach learning were or were not met. I also reviewed the summaries of each session (written based on the codes, field notes, and memos) and created a memo that kept track of learning goals for coaches that may have emerged while working with them as well as the activities that may have supported the coaches in achieving these goals.

In addition, I analyzed interview data to assess the extent to which the coaches reported that their participation in the coach PD sessions positively impacted their PD facilitation practices. Then, considering the planned and emergent goals, the intended and enacted design, and the coaches' reports in interviews, I wrote a memo to provide empirically grounded feedback about the implementation and effectiveness of this PD designed to support the coaches and provided concrete recommendations for revising the design for future work.

CHAPTER IV

FINDINGS

In this chapter, I present the findings from my analysis by chronologically describing work done in the coach PD session and the coaches' PD facilitation practices in the subsequent pilot teacher PD for each of the three cycles. In my descriptions of the coach PD sessions, I identify our short-term or immediate session goals for our work with the coaches, describe how these immediate goals relate to our long-term or overall goals (outlined in Chapter III), and explain how we conjectured our coach PD design would support the coaches in achieving these goals. I also provide examples of what I counted as evidence of progress towards these goals. In addition, I briefly describe any adjustments that were made to our design for coach PD and provide evidence of progress on the goals for coaches based on my analysis of the data collected for the coach PD session.

In my descriptions of the coaches' facilitation practices in the pilot teacher PD, I outline the extent to which there was evidence the coaches made progress towards their immediate and long-term goals. I also attend to the extent to which the coaches appeared to develop unproductive or unintended practices as a consequence of preceding coach PD sessions.

I conclude the chapter by summarizing findings and recommendations across the three cycles of support for the coaches. I also provide additional insights in terms of the enactment of the design of our supports for the coaches and modifications to the goals for the coaches' learning.

Cycle One: Coach PD Session I

Goals for Coach PD Session I

In session one, we had three immediate goals for our work with the coaches. The first goal for this session was to develop a shared understanding of the nature of the work in the three coach PD sessions. This entailed the participants (which included both members of the MIST research team and the coaches as well as other present district leaders) developing a shared vision of our joint work and shared reasons for working together. Specifically, we aimed for all participants coming to understand that the MIST research team would not be modeling or demonstrating a PD that was to be "handed off" to the coaches and then implemented with teachers. Instead, we would work together on developing practices of PD leadership. Also a primary goal of this work was to support the development of the district leaders' capacity to provide HQPD via supporting the learning and development of the coaches.

Developing a shared understanding of the nature of these sessions was important because previous coach PD in this district had followed a train the trainer model (i.e. the coaches were expected to "take back" what they did during the training to their campuses and lead the teachers at these campuses in the very same PD they had received). We conjectured that progress towards this goal would be necessary because designing PD together provided a context in which to address our other goals.

We conjectured that providing opportunities for explicit discussions about how we planned to work jointly together and what we hoped to accomplish across the three sessions would be a means of support for this session goal. It is important to note that we realized that merely discussing what we envisioned for these sessions would not suffice. However we hoped

that having these types of discussions would encourage the coaches to cooperate with us even if they did not yet fully understand the nature of the work, thus enabling us to negotiate ways of working together as we actually began to engage in joint work.

Examples of what I looked for as evidence of progress as it relates to this session goal during this session include attending to who talked about the nature of the work and how they described the working relationship between the MIST research team and the district participants. In addition, I looked for instances in which one or more of the coaches explicitly negotiated their understandings of the nature of our joint work either with the researchers or with some of the other participants. I also looked for signs of the coaches actively participating in planning the teacher PD session (e.g. taking the initiative by suggesting activities and questions for the upcoming teacher PD). Given that the intent was to support the coaches in understanding that our work together was meant to be a collaborative effort in which we co-designed the subsequent PD for teachers rather than the MIST research team handing off teacher PD to the coaches, I also analyzed the subsequent teacher PD that the coaches led. Specifically, I looked to see whether the coaches facilitated activities and discussions that were not implemented or discussed during this coach session (i.e. the extent to which the teacher PD sessions that the coaches designed and led were distinct from the preceding coach PD session we had all co-participated in).

The second goal for this session was to develop a shared understanding of the logic of a CMP2 lesson and of district B teachers' current understanding of the phases of CMP2 lessons. In other words, we aimed to assess the coaches' understanding of the purposes of the three phases of the CMP2 lesson structure and if necessary, support them in developing understandings that can be justified in terms of opportunities for students to develop conceptual understanding of key mathematical ideas. In addition, our goal was to assess the coaches' understanding of district B

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teachers' current perceptions of the purposes of the phases of the lessons. For example, MIST data indicated that district B teachers' main goal in implementing CMP2 lessons was to get through the lesson smoothly, and that procedurlizing tasks and "hooking" students were two key ways in which they attempted to do so. In contrast, the intended objective of CMP2 lessons is to support all students' development of conceptual understanding by situating mathematics problems by building on their solutions to cognitively demanding tasks. Thus our goal was to first see if we and the coaches were on the same page in terms of the teachers' perceptions and, if not, to support the participants in developing views that more closely aligned with ours.

We conjectured that making progress towards this session goal would be a precursor in supporting the coaches in making progress towards our first long-term goal of viewing instructional improvement as a developmental trajectory rather than as rectifying deficits in teachers' current practices. In particular, we conjectured that work on this goal would involve discussions of why considering teachers' current perceptions and practices may be important when designing and leading professional learning opportunities, and that this might be a first step in viewing instructional improvement developmentally. We also conjectured that a sophisticated understanding of the logic of CMP2 lessons could constitute a goal for teachers' learning and would thus be a potential developmental endpoint for teachers.

We conjectured that providing opportunities for participants to share their understanding of the logic of a CMP2 lesson as well as their thoughts on teachers' current perceptions of these phases would be a means of support for this session goal. We also conjectured that presenting relevant MIST data could be useful in the case that we needed to problematize the coaches' perceptions of teachers' current practices and understandings.

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Since this second session goal is about the extent to which the MIST research team and the coaches develop a shared understanding of the logic of CMP2 lessons, I listened to the coaches comments about the phases of the lesson and analyzed these comments for indications of their current understanding of the purpose of the phases as evidence of progress on this goal during this session. In addition, I looked for instances in which one or more of the coaches explicitly negotiated their understandings of the lesson phases either with the researchers or with some of the other participants. Since this goal is also about the extent to which we develop a shared understanding of teachers' current practices and perceptions of the phases, I also looked for the extent to which the statements the coaches made about teachers' current practices and perceptions of the phases were compatible with MIST data. In viewing the subsequent teacher PD session, I also looked for activities and questions that gave an indication of the coaches' perceptions of the lesson phases.

Our third goal for this session was that the coaches would learn to design teacher PD sessions that aimed to support teachers' development of particular instructional practices and were organized around specific upcoming lessons the teachers would teach. An example of a specific instructional practice is pressing on student reasoning during the summary phase of instruction. Our intent when supporting the coaches' planning of teacher PD sessions was to co-develop a routine for planning PD. This routine entailed 1) determining teachers' current practices, 2) clarifying the goals for teachers' learning, 3) specifying supports for building on teachers' current practices, and 4) identifying two or three ideas that they as facilitators could press on to support teachers in making progress in their goals.

We conjectured that making progress towards this session goal would contribute to our second long-term goal of enabling the coaches to design supports for teachers' learning that were

informed by ongoing assessments of teachers' current practices. In particular, we conjectured that work on this goal would involve discussions of how teachers typically enact the focal lesson and why these practices may be problematic. We conjectured that these discussions might be a first step in designing supports for teachers based on ongoing assessments of their practices. We also conjectured that progress on this session goal would be a precursor in supporting the coaches in making progress towards the third long-term goal of pressing on teachers' ideas differentially while facilitating PD because the planning routine included identifying two or three ideas on which to press teachers

We selected a specific lesson to focus on and provided opportunities to plan teacher PD that was designed around this focal lesson as a means of support for this session goal. These opportunities to plan teacher PD included time for the participants to solve the focal lesson task and a chance to experience whole class discussions of the task as students. We also suggested that the coaches focus specifically on supporting teachers in developing the practice of facilitating whole class discussions while they designed and led teacher PD. In addition, we planned to initiate the co-development of a routine for planning teacher PD as a means of support for this goal.

As evidence of progress towards the third session goal, I looked for evidence of the coaches' goals for teachers' learning and considered whether they focused on specific instructional practices. Also, I looked for evidence that the coaches were participating in the development of a planning routine and were appropriating this routine.

In the following section, I outline the extent to which there was evidence the coaches made progress towards these three session goals.

Supports Provided for Coaches during Coach PD Session I

It is important to clarify that we had originally planned for this coach PD session to only be a three-hour session. Towards the end of the activities we had planned, the coaches shared that they were concerned about finding the time to get together and actually put together a specific plan for the upcoming teacher PD. The MIST research team and the coaches agreed that we could meet for an additional two hours to develop a more concrete plan for the pilot teacher PD that the coaches would be leading. Because the coaches appeared to find this additional activity helpful, the MIST research team extended the subsequent two coach sessions in a similar manner.

Evidence of Progress towards Goals for this Session

Goal one: developing a shared understanding regarding the nature of our collaboration. Recall that we conjectured that having explicit discussions of how we envisioned working with the coaches and what we hoped to accomplish through this work would support the coaches in at least cooperating with us as we negotiated ways of working together. I found only one participant (Cathleen, a district math leader) and one facilitators (Paul) spoke explicitly about the envisioned joint work during this activity, and their contributions indicated a shared understanding of the work. However, it is important to note that there were no explicit prompts for the coaches to share their thoughts during this discussion. As a consequence, the researchers could not assess the extent to which they and the coaches were on the same page in terms of understanding the nature of our collaborative work. This could have implications for the design of work in the future, an issue that I will discuss in detail later.

There were, however, opportunities for the coaches to share their thoughts and ideas about designing and leading the pilot teacher PD sessions. Thus, I attended to the suggestions the coaches made and examined their justifications for what they planned to do with teachers for evidence of progress on the goal of developing a shared understanding regarding the nature of our collaboration.

I saw evidence of a shift in the way that at least one of the coaches, Amanda, was conceptualizing the work of planning teacher PD from attempting to take up the activities in which she engaged with the researchers and reenact them with teachers, to considering whether individual activities would be useful with teachers and articulating her assessment of whether they would support teachers' learning. For example, the following exchange took place between Amanda and one of the facilitators, Kara, as they were planning the upcoming pilot teacher PD:

Amanda:	So we're basically going to be doing what you just did for us... we're mimicking that with the teachers.
Kara (F):	If that makes sense or if there are parts that don't-I mean.
Amanda:	And that's part of us getting together to figure out.

In this instance, Amanda shared her initial assumption that the coaches would "mimic" the activities in which they engaged with the researchers when they led PD sessions with teachers. Then she responded to Kara's attempted clarification with a statement that more closely aligned with the researchers' vision for the joint work by stating that the intent was to collaboratively figure out what made sense to do with teachers.

Other examples that demonstrate a shift in Amanda's conceptualization of this collaborative work occurred during the afternoon when we reconvened to do more concrete

planning. For instance, Amanda started the afternoon off by asking, "Now would we go with what you did initially with the three phases and we'd talk about each one? Was that part of this whole thing that we're doing with the teachers? I know you had the three slides up there." Again, considering the way coach professional development had been structured historically in this district, namely following the train the trainer model, it is reasonable that Amanda would have the perspective that planning PD for teachers following the same design used in coach PD sessions is appropriate.

Both of the facilitators responded to Amanda's question by pushing back and attributing authority to the coaches. As part of Paul's attribution of authority he refocused the group by prompting the participants to think about the goals for teachers' learning. All three coaches responded with suggested goals and both of the facilitators shared some preliminary thoughts about these goals. For example, Malcolm suggested that a goal should be for teachers to develop an understanding about the three phases of a CMP2 lesson and the purpose of each phase in terms of supporting student learning. And Paul revoiced this goal and stated that the development of such a sophisticated understanding and appreciation for the three phases of the lesson would require significant learning for many of the teachers in district B. Amanda followed this by saying,

> I really liked when you first started and we had that time to talk about the three phases and then the questions that you had up there. It wasn't just what we thought but what learning was going to take place for each of those three. And I think that's one piece that made me think and challenged me and I've done it before. So I think just having definitely having the teachers go through that- that's where that appreciation piece would come into place.

In this exchange, Amanda suggested that the coaches' plan to have a discussion about the three phases of the lesson similar to the one we had during this session. However, she also provided a rationale as to why she thought the discussion would be constructive to have with teachers.

Specifically, she suggested that having this discussion would support teachers in developing an understanding about the phases of the lesson which was a previously mentioned goal for teachers' learning. Thus here we see evidence that Amanda's suggestion to use an activity from this session was about supporting teacher learning and not merely about figuring out what the coaches are supposed to do with teachers.

Later, while still planning for the upcoming pilot teacher PD, Amanda offered the following suggestion:

Amanda: I definitely think that we need to do the show and tell. Like how you guys did... just the fact that they went up there and just read what was up there and then they sat down. I think that was- because I'm sure that may strike a cord with some of those teachers like 'ooo, that's what I do'.

Again in this example, Amanda suggested that the coaches incorporate an activity in which they had engaged during this session into their plans for the pilot teacher PD. Specifically, she suggested that they model a "show and tell" discussion that may occur during the Summary phase of a lesson as we had done. But she also articulated why she thought it would be beneficial for teachers and conjectured what they might learn. In this case, she thought that modeling a "show and tell" discussion may support teachers in reflecting on their current practices and may even reveal what may be problematic about these practices (e.g. students only have opportunities to read/share what they did and then they sit down without any genuine discussion taking place). Note that this idea of revealing to teachers why "show and tell" discussions do not provide adequate opportunities for students aligns with the goal of supporting teachers in developing more sophisticated understandings of and an appreciation for the purposes of the three phases of a CMP2 lesson. Thus, the justification Amanda offered is significant considering the goals of the pilot teacher PD.

In both of these instances, Amanda contributed in ways that demonstrated that, even though she suggested that the coaches use activities that were used during their PD session, she considered how these activities may be beneficial for teachers and made conjectures about what the teachers might learn as they engaged in these select activities. The reasons that she suggested were consistent with the goals for teachers' learning that the coaches had specified earlier. In other words, Amanda shifted from suggesting that the coaches take and use what we had done together without any rationales or justifications to suggesting that the coaches use specific activities in order to support teachers' attainment of previously mentioned goals for teachers' learning.

Though Alice, another coach, did not contribute in ways that explicitly indicated a shift in her view of our collaborative work, there were indications by the end of this coach session that she too was thinking about certain activities that may be beneficial to enact with teachers and even offered specific reasons. For example, during the afternoon portion of this coach session while planning for the upcoming pilot teacher PD, Alice made the suggestion that it would be a good idea to model both the show-and-tell and the more genuine whole class discussions for teachers and gave the following rationale when pressed:

Alice: I was going to say let the two people come up and just tell what's on there-

Kara (F):   And you just not say anything

Alice: Yeah and say "Okay"-

Kara (F):   -And then do it again but then when they come up

Alice: - and then maybe say, "let's try something". And then the true summary starts from there. And then talk about what was different between you guys coming up and telling versus what I was asking.

Paul (F):   And why it matters for kids learning

Alice: Right

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Paul (F):   But what's the purpose of that modeling? What are you hoping to accomplish?

Alice: To show them how much discussion and in-depth they can get into versus just having a kid say, "This is what I did".

In this example, Alice added to Amanda's previous suggestion that the coaches model a "show and tell" discussion by adding that they should follow that up by modeling a "true summary". Importantly, when she was pressed by one of the facilitators she clarified that modeling the two types of discussion one immediately after the other could enable teachers to compare their quality and depth. Because Alice was able to provide a rationale that was based on supporting the teachers as learners, there is evidence that she did not merely plan to imitate an activity we had done together without thinking about how or why it may support teachers' learning. Also note that this activity and Alice's rationale for using it aligns with the goal of supporting teachers in developing more sophisticated understandings of and an appreciation for the purpose of the Summary phase of a CMP2 lesson. Thus, the justification Alice offered is relevant considering the goals of the pilot teacher PD.

The third coach (Malcolm) tended to be the quietest of the three coaches and often did not participate without first being explicitly prompted to do so. However in one of the few occasions where he spontaneously shared with the group, there is evidence that he viewed the purpose of our collaborative work as being more than train the trainer. In this instance, which occurred while planning for the upcoming pilot teacher PD, Kara asked the coaches how they might assess teachers' understanding of the phases of a CMP2 lesson, and Malcolm responded by suggesting an original activity.

Kara (F):   Like one question too is, would it be useful for you to ask them what they think the purposes [of the lesson phases] are so you can get an assessment of what they think to like inform future efforts? Or if you already think you already know-

Malcolm: -The purposes of the three phases?

Kara (F):   (nods)

Malcolm: I thought about a anticipation guide and going through that first. Um, I have- what did I write? Like "learning takes place in the Explore phase of the lesson" and do they agree or disagree with that. Or "the Launch is a hook and the students need to be engaged".

In asking her question, Kara essentially suggested that the coaches ask teachers what they think are the purposes of the phases of a CMP2 lesson. Malcolm responded by suggesting an activity consistent with this idea. Namely he suggested that they go through an anticipation guide with previously prepared statements that the teachers would be prompted to either agree or disagree with. He had already started drafting the statements and shared a couple of them with the group.

In this example, there is evidence that Malcolm did not view the purpose of this coach session as learning activities that they would then reenact uncritically with teachers during teacher PD. Rather, by planning and beginning to prepare activities that are distinct from the activities that we had done together during the session, there is evidence that he views this session as a time for active collaborative planning which aligns with the MIST research team's views of the nature of this collaborative work. However, the facilitators did not press Malcolm for a rational for his suggested activity. Thus, we could not determine the extent to which he was thinking of teachers as learners and made conjectures about *what* the teachers might learn as they engaged in this activity.

Recall that we conjectured that making progress towards this first session goal would be necessary if designing PD together was to provide a context in which to address our other goals. We also conjectured that having explicit discussions of how we envisioned working with the coaches and what we hoped to accomplish through this work would support the coaches in at

least being willing to cooperate with us as we worked together to navigate this new and different form of interacting (compared to previous coach PD in this district). As there were no indications of resistance from the coaches, it is reasonable to infer that they were willing to cooperate. This cooperation made it possible for us to begin the work of planning teacher PD together, and it was while we were actually planning that there were initial indications of increasingly shared views of our collaborative work. I have highlighted evidence that the three coaches made contributions that demonstrated that they were developing views about our collaborative work that aligned with those of the MIST research team. Though these instances occurred long after the initial set up discussion at the beginning of the session, the initial discussion might have elicited the coaches' cooperation.

Goal two: developing a shared understanding of the logic of a CMP2 lesson and the extent to which teachers need support in developing this understanding. Recall that we conjectured that providing opportunities for participants to share their understanding of the logic of a CMP2 lesson as well as their thoughts on teachers' current perceptions of these phases would enable us to assess the extent to which the coaches and the MIST research team were all on the same page. In the case that we were not on the same page, we conjectured that it would be helpful to present relevant MIST data in order to problematize the coaches' perceptions of teachers' current practices and understandings.

The coaches readily shared their thoughts about the phases of a CMP2 lesson and explained the purposes of the phases in terms of supporting student understanding. For example, when Kara asked the participants to explain the purposes of the various phases, the two curriculum specialists responded and then Malcolm proposed:

Malcolm: [The Launch is] preparing them [(students] for the learning… in giving them that- their prior knowledge. Making sure they have that prior knowledge in place or making sure they understand the context of the problem. You know, if it's relating to skiing - it's just preparing them so that they can be successful in the task.

Later Amanda added,

Amanda: I also see the Launch is, right at the end - right when you're just about to finish, is going back to - and making sure that that main goal of the lesson, that challenge, you know… I mean there's [parts] A, B, C, D but it's giving them that specific task overall; what's going to happen. And making sure that we are going back to that and making sure the kids are able to verbally tell you what they are actually going to be finding while they do [parts] A, B, C, D. They're going to figure out who is going to be the best company to buy T-shirts or you know rent flags from and so it's just making that you know that overall - making sure that they understand what they are going to find and not just do random problems for no reason.

In both of these examples, the coaches framed their thoughts about the purpose of the Launch in terms of supporting student understanding. Specifically Malcolm shared that the Launch phase is where the teacher should support students in developing an understanding of the problem or scenario, and should also ensure that students have the prior knowledge necessary to be successful in completing the task. Amanda shared that the Launch is the phase where the teacher supports students in developing an understanding of the problem-solving scenario and what they are being asked to do. These purposes are significant and involve ensuring that students can engage with the task productively.

When Kara asked about the purpose of the Explore phase, Alice suggested:

Alice: I was going to say to allow the kids time to actually engage in the task and use each other and the knowledge that they have with their peers to build their knowledge.

In this example, Alice's explanation of the purpose of the Explore phase focused on students' understanding as well. In particular, Alice indicated that the purpose of the Explore phase is to provide students time to work on the task and share what they know with others in order to develop deeper, more sophisticated understandings of the mathematical ideas. This purpose is

important in supporting students to exchange, make connections between, and generalize across

various mathematical ideas, which is important in supporting conceptual understanding.

Later, Kara asked about the purpose of the Summary phase.

Kara (F):   What would be the purpose then of the summary, when they come together as a whole class? What's should be accomplished in the Summary phase?

Malcolm: The sharing of the ideas or the knowledge that was gained in the Explore as well as clearing up misconceptions that may have-

Kara (F):   So students would be sharing their thinking?

Malcolm: Yes.

Kara (F):   And when they are doing that - because there were two things, let me get both of yours but let me go back to this one first. So the students are sharing and the teacher might clarify misconceptions.

Malcolm: Or the students actually could clarify misconceptions as well.

Kara (F):   So the students share their thinking, what's the purpose of that? Why would students discuss how it is they are thinking about the problem?

Alice: There may have been more than one avenue that the kids could have taken to get to their answer, so it's important that the kids see several different strategies.

Kara (F):   And why is that important to start to see different strategies?

Alice: Well they may see that you know their peer did something that they did not think of but it was more effective. So they may go and start using that way instead of what they originally were thinking. So looking for more effective strategies that could be done to answer the same type of problem.

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(A non-coach participant shares and Kara revoices and connects this contribution to Amanda's contribution)

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Kara (F): Malcolm you also said teachers might be clarifying misconceptions or students might be clarifying misconceptions in this (pointing to the white board space where she is charting the purposes of the Summary phase). Could you say more about that? What might that look like? Or, why is that important?

Malcolm: I guess when the students are sharing their thinking on a certain subject, their explanations may not match what they actually did and so in their discussion, students may say "well you said this, but this is actually the process I used to do that" and just kind of pushing back or piggy backing off of each other clarifying what is the process you actually used to solve the problem.

In this episode, Malcolm responded that the purpose of the Summary is for students to share ideas and address any misconceptions that they may have. Kara then pressed the participants to further clarify the purpose of the Summary, and Alice said that it is important for students to see several different strategies. This response might indicate that Alice considered a show-and-tell discussion adequate because a variety of strategies are presented.

In response to Alice, Kara again pressed by asking why it is important for students to see the different strategies and Amanda replied that students may see more effective strategies for solving similar types of problems that they could then try in the future. Note that Amanda's response again indicates that show-and-tell discussions might be adequate. Shortly after Amanda's reply, Kara returned to Malcolm's point about clarifying student misconceptions and asked him to share what clarifying misconceptions might look like and why it is important. In his response, Malcolm emphasized the importance of students having opportunities to question one another and to clarify their solution processes for other students. This aspect of the Summary is important in supporting conceptual understandings because these types of discussions support students in representing and communicating key mathematical ideas and demonstrating conceptual understanding.

It is important to note that there were no other episodes that indicated that the coaches had any other understandings of the lesson phases. The coaches explained the purposes of the

phases of CMP2 lessons in terms of supporting students' development of mathematical understanding. Alice and Amanda described a discussion that supports students in understanding that there are multiple ways of solving tasks and that some may be more efficient than others. However, only Malcolm described a discussion that clearly went beyond show-and-tell. Specifically, he talked about the Summary as being a phase where concepts that students may have misunderstood can be further explored by encouraging students to press on and make connections to the strategies that have been shared.

The purposes of the Launch and the Explore phases of a CMP2 lesson that the three coaches shared aligned with the intent of the curriculum. Thus the coaches' contributions indicated an understanding of the logic of these two phases that went beyond merely being able to facilitate a high-quality Launch and Explore as teachers. This understanding is significant because being able to articulate the *why* of ambitious practices is an important part of supporting others in developing such practices. Unfortunately the MIST research team did not notice that only Malcolm demonstrated such an understanding of the Summary phase.

I also attended to the extent to which the coaches' views of teachers' current instructional practices were consistent with MIST findings. Immediately following the discussion of the phases of a CMP2 lesson, we asked participants about teachers understandings of the purpose of the lesson phases. After recording the participants' responses on chart paper, the facilitators shared aggregated data collected the previous year from interviews with teachers from the district. Throughout this exchange, there were strong indications that the MIST research team and the coaches shared consistent views of the teachers' perceptions of the purpose for the phases of a lesson. For example, Kara led a discussion where she explicitly highlighted some of the consistencies in our views:

Kara (F):   ...those (pointing towards the screen projecting a PowerPoint slide) were what we were hearing and I think that they really fit with what we heard around the table

Paul (F):   Maybe you could read them out?

Kara (F):   Yeah, so the hooking students, engaging students, getting students excited, and showing them how to do the task. So that fit (pointing to notes she had just taken on the chart paper and laughs) here. So we were hearing very similar things to what your observations were. Uh, as far as the Explore,...what we heard from teachers was that the most important thing was that they get the right answer in that phase. And I think that that fits with (points to a different section on the chart paper) this goal of just trying to get it right and just get through the lesson and to the right answer. And then with the Summary.... (pointing towards the power point on the screen) this is what we were hearing from teachers is checking answers to make sure they are right which I think Alice you said that word for word. And um, students feeling good about themselves and showing their work. Which again is not like a bad thing but there wasn't really much discussion at all around really trying to press all kids' learning in that particular phase. So I think we have data points but then you all have really valueable data from working with teachers and it seems like they're both very similar.

In this excerpt, Kara pointed out the commonalities between what the coaches had shared and teachers' responses to questions about the purposes of the lesson phases during interviews. Specifically, the coaches' contributions indicated that teachers viewed the purpose of the Launch as to get students excited and to demonstrate how to solve the task, which was consistent with MIST data. Also consistent with MIST findings, the coaches shared that teachers thought that the purpose of the Explore phase was to ensure that students solved the task correctly. Lastly, the MIST data and the coaches' contributions both indicated that teachers thought the purpose of the Summary phase was to check students' answers. It is important to note that these purposes involve helping students produce the correct answer and allowing teachers to get through the lesson smoothly, rather than in terms of supporting the development of conceptual understanding.

Recall that we conjectured that making progress towards this session goal would support progress towards the first long-term goal of supporting the coaches in viewing improving

teachers' instructional practices as a developmental trajectory rather than rectifying deficits. The intent of the activities in which the coaches shared their understanding of the logic of a CMP2 lesson and their thoughts about teachers' current perceptions of these phases was to enable us to assess the extent to which we were all on the same page. The coaches' contributions suggested that we agreed on the purposes of the Launch and Explore phases of CMP2 lessons, and on teachers' perceptions of all three phases of CMP2 lessons. We conjectured that this shared understanding could serve as a sufficient basis for clarifying goals for teachers' learning and for planning teacher PD together. In other words, we anticipated that this shared understanding would serve as a precursor to supporting the coaches in developing a developmental stance on teacher learning and in designing PD based on this stance.

Goal three: designing teacher PD sessions that focus on specific instructional practices. Recall that we conjectured that selecting a specific lesson to focus on and providing opportunities for the coaches to plan teacher PD that is designed around this focal lesson would support them in designing PD that focused on specific instructional practices. I found that only one of the coaches, Alice, spoke about specific instructional practices while talking about the goals for teachers' learning. The other two coaches, Amanda and Malcolm, spoke more generally about what they hoped teachers would learn from their PD. For example, the following exchange occurred during the afternoon portion of this coach session when Paul asked the coaches to think about their goals for teachers:

Paul (F):   What do you hope they'd learn to know or be able to do differently or better by the time you get done with them?

Malcolm: I guess to see the three phases to make what they're doing effective so that, so that students are learning but that they are going through those phases effectively. Preparing the students in the Launch, and then going through the Explore, and then making sure they do that Summarize piece and having those discussions.

Alice: I would say, if we are being very deliberate on the lessons that we're picking to do this with, that my hope would be that they would start thinking this way for all of the lessons they plan so that they are very deliberate in the questions that are planning to ask. Things like that.

Amanda: Yeah, I mean it's the same. It's being able to take from what we - the PD that we provide for them and being able to use that in their everyday instruction. And being practical with it and being real and having them talk about their concerns but also this is what could happen and it could happen effectively.

In this excerpt, Malcolm did not highlight any specific instructional practices but instead indicated that his goal was for the teachers to enact the phases of a CMP2 lesson effectively. Amanda shared the general goal that teachers would use what they learn in their everyday practice. However, Alice shared that she specifically hoped that teachers would be more deliberate in their questioning of students. It is important to note that being deliberate in questioning students is an essential component of ambitious instruction and is a "high-leverage" practice (Ball & Forzani, 2009) that can be implemented during any phase of any lesson.

Immediately after this exchange, the discussion focused on teachers' current practices. During this discussion, Amanda said:

Amanda: Even like the different strategies they [teachers] put in place or they think about certain things but then it's not executed effectively. And so I think that a lot of them have a basic understanding? And they try? But I think the goal for me, for this would be that they can go in and be confident and do it effectively.

In this instance, Amanda proposed another general goal, that teachers would be confident and could more effectively implement the lessons.

Later during this conversation about teachers' practices and goals for teacher learning, Kara suggested that most of their proposals could be considered long-term goals for teachers' learning, and the coaches agreed. The following exchange occurred:

Kara (F):   Maybe it would be good to think short term or just for the particular session?

Amanda: What was the question?

Kara (F):   If those are the long-term goals, what would be good short term or just for the particular - the one that is going to happen? What do you think would be reasonable I guess?

Amanda: To be able to implement this lesson. I mean if we are looking at *that* short term it would be *this* lesson effectively and then reflect on that lesson and be able to apply it to others.

Paul (F):   And what do you hope they would do in implementing this lesson that they otherwise wouldn't do but for this work with you?... These teachers can already teach that lesson after a fashion. They've probably taught it before and what do you hope they'll do differently or better because of the session they - you are going to conduct with them?

Alice: Knowing the way they are doing it now, they are doing the show-and-tell or they're doing, "let's go over how to get the right answer". So I would want to see them as they're going around the room during the Explore asking those clarifying questions and those probing questions. I would want to see them to be looking at the different solutions and keeping a mental picture of "Oh I want this kid to say something when we talk about it later" and then during the Summary actually go a little bit deeper just like Kara did. She didn't have to go through each of the items to solve it but she focused on- and I'm sure she would've picked one that would've ended up in a decimal if we had more time- but she just picked a couple to discuss and talk about and go deeper on.

Paul (F):   So in other words it sounds like you're wanting them to go beyond the show-and-tell.

Alice: (nods)

Kara: So Summary beyond show-and-tell (talks aloud while writing on the board).

In this excerpt, after Kara refocused the group by asking for specific short-term goals, Amanda again offered a general goal for teachers. Paul then rephrased the question and Alice responded by indicating actual practices that she wanted to see teachers enact during the Explore phase: asking clarifying and probing questions, and identifying student solutions that they wanted to discuss during the Summary phase of the lesson. Again, these are specific instructional practices that can be enacted in any lesson. The facilitators revoiced Alice's contribution by saying the goal was for teachers to go beyond show-and-tell discussions. However, this revoicing might have overly simplified her response by backgrounding the specific instructional practices

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that she described. As a consequence, these instructional practices were not recorded on the board and thus were not made available for participants and facilitators to reference during the remainder of the session.

Recall, that our intent in supporting the coaches in designing teacher PD around focal lessons was to initiate the co-development of a routine for planning PD. I found that though the facilitators proposed aspects of a routine, the coaches did not actively contribute to the constitution of this routine. For example, while planning for the upcoming pilot teacher PD Paul offered the following suggestion:

Paul (F):   When we go about designing, you know whether it's for teachers or school leaders or- I teach a pre-service methods class for people who are going to be teachers...it really helped us always to say, "What are the goals we are aiming for?" The long-term goals, so that was always one thing we attempted to clarify. And, "What are the starting points? What do we know about, in this case our learners are the teachers, about how they currently think about things and what are they currently doing?". And you've got a much better read on what they are currently doing probably then we do. Especially at particular campuses. Uh, and then you say, okay so here's the goals, not just for this session, the longer-term goals; here's the starting points then we can begin to think about what might want to do in a session. Is that a way maybe to move forward?

In this example, Paul explicitly suggested that the group use planning practices that he and Kara had used in other contexts as a starting point for planning teacher PD. Though the coaches had participated in the prior discussions of immediate and long-term goals for teachers' learning and teachers' current practices as Paul had suggested (see previous excerpts), none of the coaches actively contributed to the establishment of this as a routine and none suggested additional PD planning practices.

It is important to note that this was the first time that the MIST research team and the coaches had worked together to plan PD. Thus, it is likely not surprising that I found no evidence that the coaches contributed to the co-development of a routine during this session. When I

analyzed the two subsequent coach sessions, I also attended to the extent to which the coaches participated in the constitution of a planning routine and appropriated this routine.

Recall that we conjectured that making progress towards this third session goal might be a first step in supporting the coaches in designing supports for teachers based on ongoing assessments of teacher practices. We conjectured that initiating a planning routine that involved explicit discussions about the goals for teachers' learning and their current practices would support the coaches in designing teacher PD that built on current teacher practices. We also conjectured that selecting a focal lesson in which to ground our discussions of teachers' practices would support the coaches in designing PD that focused on specific instructional practices. However, only one coach made contributions that demonstrated that she was thinking of particular instructional practices during these discussions. Furthermore, none of the coaches took up Paul's suggestion that planning practices should include explicit discussions of teacher current practices and of the goals for teachers' learning.

Summary

During this session:

- The three coaches made contributions that demonstrated that they were developing views about our collaborative work that aligned with those of the MIST research team

- The three coaches also made contributions that demonstrated that we were on the same page in terms of our assessments of teachers' current understanding of the logic CMP2 lessons. In addition, though there was evidence that the coaches shared our understanding of the purpose of the first two lesson phases, only one coach demonstrated an understanding of the Summary phase. This is significant because the Summary phase of the lesson was to be the

focus of the work that the coaches were planning to do with teachers (i.e. though the focal

lesson changed for each cycle, we continued to support the coaches in supporting teachers in

deepening their understanding of the purpose of Summary phase and in planning and leading

productive concluding whole class discussions).

- Only one coach made contributions that demonstrated that she was thinking of particular

  instructional practices during discussions of goals for teachers' learning. This is significant

  because the practices identified as goals for teacher learning directly influence the activities

  that are designed to support the development of these practices.

Cycle One: Coaches' PD Facilitation Practices in Pilot Teacher PD Session I

Prior to our collaborative work with them, the coaches designed PD activities that

focused on peripheral aspects of mathematics instruction (opposed to activities that were rooted

in specific lessons or in concrete, shared experiences). Also, it was unclear how the different

activities that the coaches facilitated were connected to each other. Thus, it was difficult to

discern a specific set of learning goals for the PD sessions. In addition, their facilitation indicated

that they needed support in developing meaningful ways of building on teachers' contributions.

Based on this assessment of the coaches' initial PD practices, members of the research team

developed goals for our collaborative work and conjectured supports for the coaches.

Recall that our supports for the coaches included providing opportunities for them to

rehearse or try out PD facilitation practices in the context of pilot teacher PD. Six days after the

first PD session, the coaches co-led a pilot teacher PD that was video-recorded. This teacher PD

was designed to support 6th grade teachers in planning and teaching a lesson on moving from

fractions to decimals. In the following section, I describe the coaches' facilitation practices and

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outline the extent to which there was evidence the coaches made progress towards the goals for

coach PD session 1 as well as the three long-term goals. I also attend to the extent to which the

coaches developed unproductive or unintended practices as a consequence of the coach PD

session.

Evidence of Progress towards Goals for the First Coach PD Session

       **Goal one: develop a shared understanding of the nature of the collaborative work of
the coach PD sessions.** Recall that the first goal for the first coach PD session was that the

coaches would come to understand that the MIST research team intended to work collaboratively

with them on the practices of PD leadership (rather than modeling or demonstrating a PD that

was to be "handed off" to the coaches and then implemented with teachers). In reviewing the

video from the teacher pilot PD, the coaches used the same power point slide that the MIST

research team used while explaining the nature of the collaborative work and the cycles of PD

within this work. However, one of the coaches used a "train the trainer" framing when she

described the cycles.

       After briefly introducing herself and the other two coaches, Alice put up the "Coherent

Instructional System Cycle" power point slide (see figure 2) and said:

Alice: This whole process came about because we've been working with the Vanderbilt University for the past six years on different campuses and it's a partnership really with [District B]. And Vanderbilt and [District B], they've planned a session together (points to the first bubble in the first phase of the cycle). They present professional development to all of your principals and they did that on October 18th (points to second bubble in the first phase of the cycle). Then the three of us along with the Curriculum Specialists receive that same presentation (points to third bubble in the first phase of the cycle). And guess why you're here (big smile on her face while pointing to the words printed under the third bubble in the first phase of the cycle)? We're piloting the PD with you. Um, we're going to be looking at a specific lesson that you'll be teaching within the next week or so and your principals will be going into your classrooms and looking at those lessons and bringing feedback back to *their* meetings.
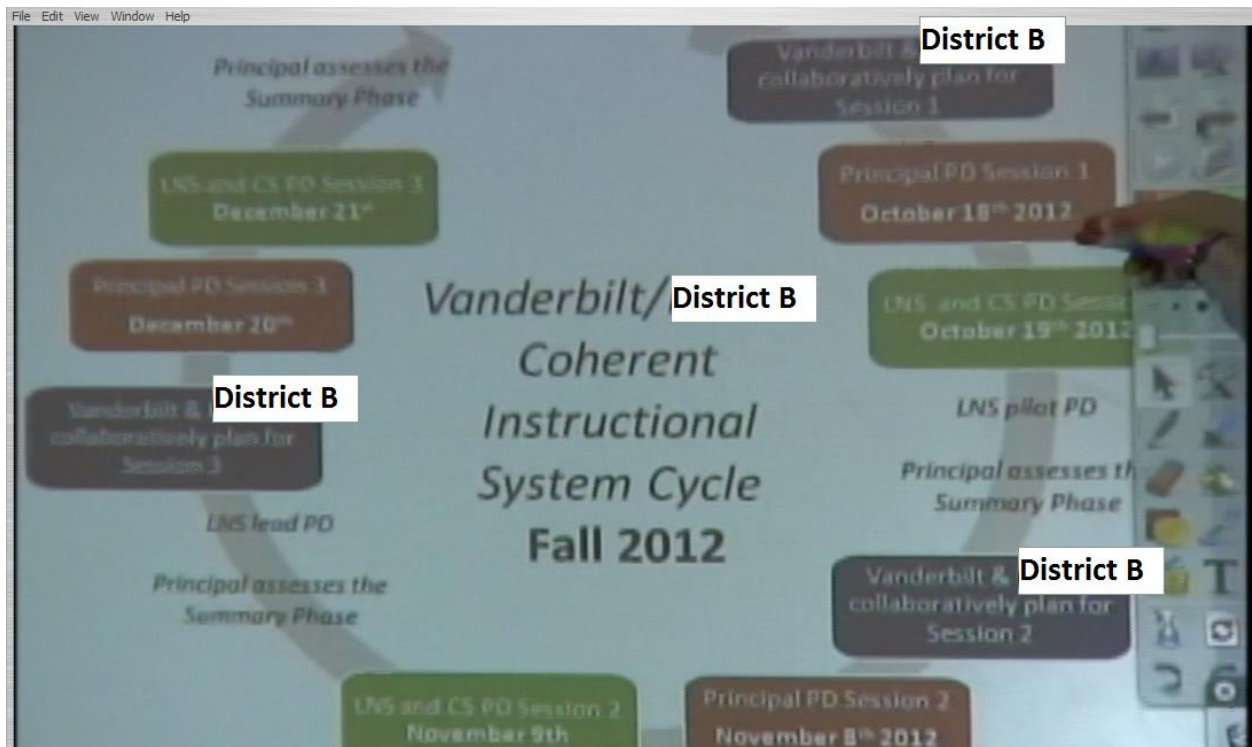
Figure 2: Screen shot of Alice pointing to the same power point slide used in Coach PD session 1

In this example, Alice described a cycle as a series of the *same* presentation being

presented to different people within the district. Specifically, she said the research team

presented a professional development to the principals; then they (the coaches) received the same

presentation before piloting it with the teachers. By framing our collaborative work this way, Alice demonstrated a problematic view of the purpose for the coach PD sessions.

In contrast to this explicit description of our collaborative work, there was evidence that the coaches did not merely replicate the activities we had done together during the coach PD session. In fact, the coaches designed and implemented several activities that we did not do together. For example, they designed an anticipation guide in which they had prepared statements about the purpose of each of the three phases of a CMP2 lesson beforehand (e.g., "one purpose of the launch is to show students how to solve the task"). During the pilot teacher PD, they then asked the teachers whether they agreed or disagreed with the statements.

As another example, the coaches had also designed an activity that the research team referred to as the "Sorting Activity". In this activity, the coaches again prepared statements about the purpose of each phase of a lesson beforehand and then, during the pilot teacher PD, they asked teachers to work in pairs to decide which of the statements matched with which of the three phases of a CPM2 lesson. The coaches then led a whole group discussion in which they called on individual teachers to come to the front of the room and place each statement in turn in its appropriate box (Launch, Explore, or Summary) on the SmartBoard.

I will describe the other original activities that the coaches designed and enacted when I discuss other immediate and long-term goals. Though there was definitely room for improvement in both the design and enactment of these activities (which I will discuss in more detail later in this section), the fact that the coaches designed and selected activities that differed from the activities that we had done together demonstrated that they did not simply view our work during the coach session as learning activities that they would then reenact uncritically with teachers during the pilot teacher PD.

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Goal two: develop a shared understanding of the logic of a CMP2 lesson and of district B teachers' current understanding of the phases of CMP2 lessons. Recall that the second goal for the first coach PD session focused on the coaches' understanding of teachers' current understanding of the phases of CMP2 lessons and the ways it may be at odds with the intent of the curriculum. The coaches planned and implemented activities for the teacher pilot PD that were designed to elicit teachers' current understanding of the phases of CMP2 lessons. The anticipation guide and the "Sorting Activity" are two examples of activities that the coaches included as a means of assessing teachers' initial conceptions of the logic of a CMP2 lesson.

Though the intent of these activities may have been to elicit teachers' understandings, the way the activities were designed and implemented required the teachers to ascribe particular teacher practices and student learning opportunities to only one phase of CMP2 lessons. For example, one of the statements that the coaches included in the Sorting Activity was "teachers clarify misconceptions". The teacher who was called up to the SmartBoard for this statement placed it under the Summary phase as the coaches intended. However, teachers can clarify students' misconceptions in any and all of the three phases.

These activities may have surfaced teachers' understandings of the lesson phases but, they were designed so that teachers received immediate feedback that their ideas about the various phases of the lesson were correct or incorrect. For example, the following interaction occurred at the SmartBoard during the Sorting Activity:

Alice: (Reads the statement out loud to the group) Teachers question students to monitor where they are and push their thinking

FT7: (At the SmartBoard moves the statement text to the "Summary" box, and turns and asks her group members) Is this where we put it?

MT3: I can't see it

FT17:   (Reads the statement again) Teachers question students to monitor where they are and push their thinking

MT2:   Take a risk

MT3:   Teacher questions students? Yeah we put it there.

FT17:   (Attempts to leave the statement under "Summary" but it disappears, indicating that statement does not belong in the Summary phase)

Choral: Ohhhhh...aww man...uh oh

(Ts all at once)

FT17:   (Tries again, this time placing the statement text in the "Explore" box. The statement stays, indicating that the statement belongs in the Explore phase)

Alice: Good job!

Choral: (Applause)

(Ts all at once)

In this example, the teacher attempted to assign a statement to a phase that was different from what the coaches had intended and received feedback that the response was incorrect. When the teacher then placed the statement in the Explore phase as the coaches had intended, the coach leading this activity, Alice, and the other teachers responded by praising her. Because the SmartBoard was set up so that a statement could be assigned to only one lesson phase, in enacting this activity the coaches indicated that there was only one right answer. Moreover, instead of focusing on how the phases were connected, the coaches treated the phases of CMP2 lessons as discrete, which is at odds with the intent of the curriculum.

In addition to eliciting teachers' understandings of the three phases of CMP2 lessons, it was clear that the coaches wanted to support teachers in distinguishing between productive and unproductive Summaries. The coaches modeled each phase of the focal lesson with the teachers acting as students and they included two contrasting summaries, first a show-and-tell and then a

more genuine whole class discussion. They then led a reflective discussion in which teachers were prompted to compare and contrast the two summaries.

During the debriefing conversation following the modeled summaries, the coach who led this part of the teacher pilot PD, Malcolm, did not just ask the generic question of "What are the differences between the two summaries?" Instead, he asked questions about core instructional practices that emphasized some of the key purposes of the Summary phase that aligned with the intent of the curriculum. Examples of the questions he asked included:

"What piece is lacking from the Show-and-Tell Summary?",
"In our planning, what would we have to do [in order to support student discussion]?", and "In terms of what could be learned, how does the second Summary benefit the students?".

By asking what is lacking from the show-and-tell Summary, Malcolm oriented the teachers to consider some of the aspects of an ambitious discussion that are missing in a show-and-tell Summary (e.g. making connections between student contributions and pressing for students to justify the claims they make). By asking about what would need to happen during planning, Malcolm prompted teachers to think about the issues they should consider in order to have productive discussions with their students. By asking about the benefits for students of the second more genuine discussion, Malcolm supported the teachers in focusing on the students as learners. These questions prompted the teachers to talk about specific aspects of instructional practice by making explicit links to examples from the model lesson.

Immediately after this discussion of the differences between the two modeled summaries, Malcolm asked the teachers about the Explore phase of the modeled lesson.

Malcolm: So in the Explore, what things did you see Ms. X [Amanda] do as the teacher? And what things did you do as a student?

FT1:   As students we had appropriate interactions with the people at our table, you know bouncing ideas back and forth.

Malcolm: okay

FT2:   And then she [Amanda] walked around asking questions.

Malcolm: okay

MT1:   I could say the same thing. Even to the extent that when I asked a question about what kind of output [we would need], I got a question back…So it was all-definitely, I would say it was probably like 100% questions at that point in time. And it's the teacher just adding more and more guided questions…not providing any validation one way or the other. Because still in the Explore phase I [as the teacher] don't necessarily want to hamper their [the students'] potential solution…

Another teacher (from FT4's group) then shared that her group asked Amanda if they could divide and simplify because they thought it would be an easy way to solve the task.

FT4:   She [Amanda] gave us the choice and said well if that's what you like to do I mean if it's easier for you. She said - she was open for us to do it our way instead of making us do it her way. She was open for us to do whatever we needed to do instead of just following whatever she wanted us to do.

Malcolm: so my question is or what I'm wondering is how did that make you feel as a student? Did it change your thought process in any way or did it guide you in one way versus another? Or -

FT4:   Like I took ownership of our work

Malcolm: So it gave you ownership of the work

Alice: Something I noticed that Ms. X [Amanda] did was as she was going from group to group in looking at your work...she was looking at your work so she could focus in on which posters she wanted to make connections with during her Summary...

MT2:   I saw the students doing the work and not the teacher doing the work. And giving the kids time - an appropriate time to do the task and the kids were doing the work and not the teacher doing the work.

Malcolm: So the learning was in the hands of the students. Um and hitting on what Alice mentioned about Amanda going around and looking at different things, she was pre-planning the Summary. Picking out those different parts to bring up during the Summary to have that rich discussion. So the Summary is not going to just happen haphazardly. It's something you have to plan for and in that Explore, that's when you're planning for your Summary. Getting more detail and figuring out what you're going to pull out.

MT3: I don't know if she [Amanda] did this or not… but a question that you could ask a student once you notice that another student is doing all of the work is to ask the other individual, "what is it that you are learning? Or what is taking place in this particular problem?"

FT5: That's what she [Amanda] did in our group. You know what's your role, and what's your role?

FT6: And can ya'll explain it?

Malcolm: And why is that important to make sure that everyone understands what's going on and they can explain it?

FT5: They're all engaged, they're all actively learning

Malcolm: They're all engaged and actively learning but how does that impact this phase? The summary phase? How does it impact that phase?

FT3: Because she [Amanda] could have said all of you need to know this work. What if I pick you to go up? Do you understand it? Or something like that so that they take ownership of their learning.

Malcolm: Because when we were going over the posters in our group when she [Amanda] called on Alice - which I wanted to explain because I did it but Alice had to explain what I did on the 42kg of wheat crackers. So it kind of goes back to everyone has to have an understanding of what's going on and be able to verbalize that so that we can have that rich discussion in the Summary.

In response to Malcolm's initial question, the teachers shared what they had noticed about the teacher's role during the Explore phase. Specifically, the teachers said that in the Explore, the teacher should ask questions, make sure not to suggest that specific strategies are correct or incorrect, avoid telling students how they, as teachers, would solve problems, and give students adequate time to solve the task. It is important to note that these purposes of the Explore align with the intent of the curriculum.

In contrast to the Sorting Activity and the anticipation guide, Malcolm's questions during this discussion elicited the teachers' developing conceptions of the phases of CMP2 lessons. Since all the teachers participated in the model lesson (as students), they had an opportunity to develop a shared image of the practices being discussed. In fact in their responses, the teachers often made direct connections to their experiences from the model lesson.

In addition, this discussion allowed for talk about how the phases were connected. It is important to note that the teachers did not actively participate in talk about the connections, indicating that they might not have picked up on these connections. Alice and Malcolm not only emphasized that during the Explore phase teachers need to pre-plan for the Summary, but they also pointed to concrete examples of practices that Amanda modeled (e.g. deliberately calling on Alice to explain how Malcolm had solved the problem). Also Malcolm explicitly asked how the teachers' observations about the teacher and students' roles during the Explore impact the Summary phase of the lesson. Thus, the discussions of the practices and purposes of the phases of CMP2 lessons appeared to be more meaningful when it was grounded in a representation of practice and when done without the built-in constraints of activities such as the Sorting Activity and the agree/disagree anticipation guide.

The enactment and design of the activities the coaches facilitated during this PD session to support teachers in developing more productive understandings of the logic of CMP2 lessons proved to be problematic. I also found the quality of the supports the coaches provided varied across activities. Specifically, the anticipation guide and Sorting Activity only elicited teachers' understandings of the lesson phases while the model lesson and subsequent reflective discussions surfaced the nuanced understandings teachers had and provided opportunities for rich

discussions of the lesson phases that were rooted in actual instructional practices and were connected to student learning opportunities.

Goal three: designing teacher PD sessions that focus on specific instructional practices. Recall that the third goal for the first coach PD session focused on designing a teacher PD session that was organized around specific upcoming lessons and would support teachers' development of particular instructional practices. I found that during this first pilot teacher PD, the coaches planned and led activities designed around the focal lesson that was selected and used during the coach PD session. The coaches provided opportunities for the teachers to discuss the goals of the focal lesson. They also gave teachers a chance to "do the math" of the focal lesson when the teachers acted as students during the model lesson. In addition, by including a model lesson, the coaches provided an opportunity for the teachers to experience and observe actual instructional practices. Note all of these were activities the researchers had implemented with the coaches during the coach PD session.

Though the coaches clearly designed the pilot teacher PD around an upcoming focal lesson, it is difficult to discern a specific set of instructional practices that the PD was designed to target. This is not surprising given how the discussion of the goals for teachers' learning played out during the coach session. For example, recall that Alice was the only coach to name specific instructional practices as part of the goals for the teacher PD. Also recall that the practices she outlined may have been oversimplified to supporting teachers to "go beyond a show-and-tell Summary". It is clear that the coaches wanted to support teachers in distinguishing between a show-and-tell and a more genuine discussion, but recognizing this distinction is not in itself a specific *instructional* practice. Moreover, though making this distinction may support

teachers in seeing show-and-tell discussions as problematic, it does not support teachers in developing new and more productive practices.

As a consequence of this analysis, I conjecture that designing PD sessions focused on specific lessons might be a precursor to supporting coaches in designing PD focused on specific instructional practices. Any discussion around improving instructional practices is likely to remain very abstract unless it is grounded in a specific lesson. For example, in this pilot teacher PD, the coaches did not make connections between talk about the purposes of the phases of CMP2 lessons (which was abstract) and talk during and after the modeling of the focal lesson (which was connected to specific aspects of instruction). I conjecture that if the coaches had been more deliberate in making stronger connections between the model lesson and discussions of the purposes of the phases of CMP2 lessons, they could have planned and implemented PD that would have been more effective in supporting teachers in improving specific practices. I also conjecture that if the researchers had been more explicit in discussing why it may be important to do the work around the focal lesson with teachers *before* discussing specific practices or the purposes of phases of a CMP2 lesson, the coaches may have been better supported in designing such PD.

Evidence of Progress towards Long-term Goals for Our Work with the Coaches

Overall goal one: developing views of instructional improvement as a developmental trajectory rather than as rectifying deficits. Recall that our first overall goal for our work with the coaches was to support them in coming to view their role in PD leadership as supporting teachers' development of improved instructional practices, rather than as simply identifying and attempting to "fix" deficits in their current practices. In reviewing this first pilot teacher PD

session, I found evidence that coaches designed and enacted activities that reflected the assumption that the purpose of PD is to find and correct deficits in teachers' current practices. For example, the way the coaches facilitated the anticipation guide and the Sorting activity were problematic because it restricted the conversation and required the coaches to designate teachers' ideas about the phases of a CMP2 lesson as being either correct or incorrect. The design and enactment of these activities also seemed to indicate that the coaches thought that any incorrect ideas could be corrected in one activity or one session.

A subsequent exchange during the Teacher PD session indicates that one of the coaches, Alice, may have adhered to these problematic assumptions about PD and PD leadership particularly strongly. The following exchange took place immediately after the teachers participated in the anticipation guide and the Sorting Activity:

Alice: Where is the learning occuring during the lesson?

Choral: All of it....through out the whole thing...Launch, Explore, and Summary

(Ts all at once)

Alice: Oh throughout the whole thing?

Choral: Yeah

(Ts all at once)

Alice: I could see that because you're covering vocabulary so there could be potential for learning new things there (pointing to the area under the Launch label on the SmartBoard). (Points to the area under the Explore label on the SmartBoard) They could be learning from their partners when they're talking about different strategies in their group, trying to solve it together. (Points to the area under the Summary label on the SmartBoard) The majority of the students' learning is going to come from the Summary. Through the questions that you're asking; making connections between the students' work; and relating that back to the goal of the day of what they're working on. That's where the majority of the learning is going to take place.

In this excerpt, Alice asked the teachers in which phase they thought student learning occurs, and the teachers responded that they thought learning could be happening in each phase

of the lesson. Though Alice indicated that she understood why they responded in this way, in pushing back on their statements she indicated that the teachers' needed to revise their thinking. Moreover, she responded to this perceived limitation in the teachers' reasoning simply by *telling* them how they should understand where learning happens in CMP2 lessons. In addition, the view that she was trying to get teachers to understand was problematic and did not align with the intent of the curriculum.

Considering the differences in the design and enactment of the two sets of activities the coaches facilitated throughout the teacher PD (the anticipation guide and Sorting activity versus the model lesson and reflective discussion), I conjecture the research team provided inconsistent supports for the coaches as they planned the activities during their coach PD session. In terms of the model lesson (with two different summaries) and the reflective discussion, the research team modeled these activities and provided an opportunity for the coaches to participate in these activities. This supported the coaches in developing an image of these activities in action (i.e. what they look like in implementation).

After participating in the model lesson and reflecting on their own experiences, the coaches thought that it would be productive to model a lesson then lead a reflective discussion with teachers. As I highlighted before, the research team consistently pressed the coaches to provide rationales and justifications for why they thought it would be productive to do these activities with teachers, and oriented the coaches to consider their goals for teachers' learning as they incorporated the activities into their design.

In contrast, the research team used open-ended questions (e.g. "What is the purpose of the Launch phase") and pressed on the coaches' responses as a way to assess the coaches' understanding of the logic of CMP2 lessons. The research team also used open-ended questions

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(e.g. "What do you think teachers commonly think the purpose of the Launch phase is?") and pressed on the coaches' responses to assess the coaches' perceptions of teachers' understandings. In addition we used PowerPoint slides (see Figure 3) to present relevant MIST teacher interview data as a way to corroborate the coaches' responses.
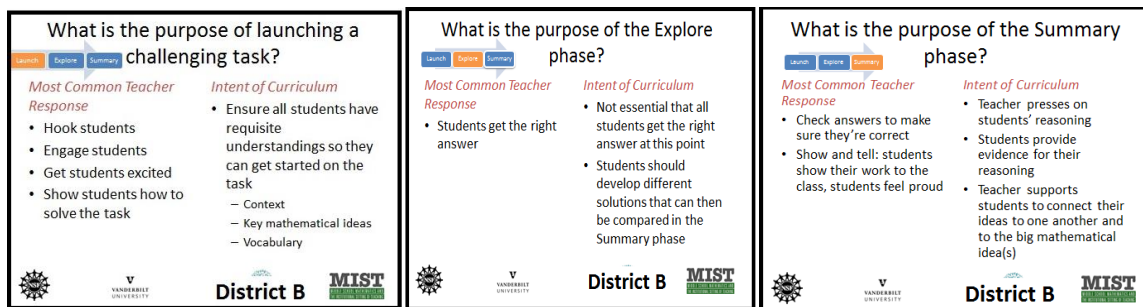
Figure 3: Images of PowerPoint slides used to present relevant MIST teacher interview data

After participating in these discussions, the coaches decided that an anticipation guide and the Sorting Activity would be productive activities to do with teachers. However, in contrast to the model lesson and reflective discussion, the research team did not press the coaches to provide rationales and justifications for why they thought it would be productive to do these activities with teachers. Moreover the research team did not ask for concrete representations of what they were planning to do. As a consequence, the researchers and coaches did not develop a shared image of what these activities would look like in action. At the time, there was no indication that the coaches' design for supporting teachers in understanding of the purposes of the phases of CMP2 lessons was problematic. However, there was nothing in the discussion of teachers' views of the phases or in our slides that would orient the coaches to think about teachers' learning around the logic of CMP2 lessons developmentally.

In other words, during the first coach PD session, though there were clear indications that

the researchers and coaches were on the same page in terms of the goals for the teacher PD, we were not always on the same page in terms of *how* to support teachers in making progress towards these goals. This is likely because we did not establish a shared image of what the work of supporting teachers in developing more sophisticated understandings of the purposes of the phases of CMP2 lessons might look like. In future iterations, consistently pressing coaches to share how they plan to support teachers as well as why they think their suggested activities would be productive may improve supports for coaches' facilitation practices.

Overall goal two: designing supports for teachers' learning informed by ongoing assessments of teachers' current practices. Recall that the second overall goal for our work with the coaches focused on supporting them to design and enact PD based on teachers' current practices. In this pilot teacher PD session, the coaches planned activities designed to elicit current teacher perspectives on instructional practices. For example the anticipation guide and the Sorting Activity surfaced teachers' understandings of the phases of lessons. However, in their enactment, these activities framed instructional practices too abstractly to influence the enactment of the other activities in this teacher PD session or to even substantially influence the design of future teacher PD sessions. For instance, during the Sorting Activity, when a teacher placed a statement under a phase of the CMP2 lesson cycle that the coaches considered incorrect, the coaches encouraged the teachers to keep trying until they got it right. When a teacher "correctly" placed the statements, the coaches encouraged the other teachers to clap and then quickly moved on to having another teacher come up and try the next statement. In other words, in addition to the abstract nature of the statements, in facilitating this activity the coaches did not press teachers to provide justifications and explain why the held the perspectives that were shared. Eliciting teachers' responses without adequately attending to the reasoning behind them

limited the extent to which the coaches could build on and influence the teachers' current understandings of the phases of CMP2 lessons.

Overall goal three: facilitating teacher PD by pressing on teachers' ideas differentially. Recall that the third overall goal for our work with the coaches was to support them in facilitating teacher PD by building on teacher contributions. I found that the quality of the coaches' press varied across activities. For example, as described above, the coaches did not press when they enacted the Sorting Activity. In addition, Alice did not press when she went over the anticipation guide at the beginning of this teacher PD session.

> Alice: We're going to go ahead and go through each statement. Thumbs up if you agree with it, thumbs down if you disagree, and if you're kind of really not sure just go ahead and do sideways. So our first statement is (reads) one purpose of the launch is to show students how to solve the task. Thumbs up, thumbs down, I'm not quite sure (teachers hold thumbs up/thumbs down; Alice looks around to survey teachers' "thumb positions"). (Alice reads) The second one, one purpose of the explore phase is to ensure that students get the right answer (teachers hold thumbs up/ thumbs down; Alice surveys teachers' thumbs). Alright, (Alice reads) in the explore phase students should develop different solutions that can then be compared in the summary phase (teachers hold thumbs up/thumbs down; Alice surveys teachers' thumbs). I think we all agree on that one. (Alice reads) In the Summary phase, the main objective is for teachers to check answers to make sure they are correct (teachers hold thumbs up/thumbs down; Alice surveys teachers). Hmm. (Alice reads) the purpose of the Summary phase is to allow students to display the work they completed in order to make conections among the different strategies students used (Alice surveys teachers). And (Alice reads) to Summarize the lesson, students shoud report out what they learned during the class. We're actually going to come back to that later in the session and see if you wanted to change your votes on any of those statements.

In this instance, teachers were not pressed to elaborate or justify why they agreed or disagreed with the statements. Rather, the teachers shared, Alice glanced around the room to get an idea of the teachers' votes, and then they moved on to the next statement.

The coaches pressed the teachers during other activities. For example, Malcolm facilitated the reflective discussion the followed the model lesson by responding to teachers' ideas differentially. As described above, Malcolm pressed teachers to elaborate what they shared

(e.g. "And why is that important to make sure that everyone understands what's going on") and made connections between contributions (e.g. "So it kind of goes back to everyone has to have an understanding of what's going on…") during the discussion. Though there was definitely room for improvement in the design and enactment of this discussion, the fact that Malcolm was more responsive to teachers' contributions and that in responding he went beyond simply moving the discussion along demonstrates his potential to facilitate PD by pressing differentially.

Summary

During this pilot teacher PD, the coaches:

- Designed and selected activities that differed from the activities in which they had participated during the coach PD session, demonstrating that the coaches did not view our work with them as opportunities to learn activities that they would then reenact uncritically with teachers during the pilot teacher PD.

- Facilitated activities that were designed to elicit teachers' current understanding of the phases of CMP2 lessons. However, the way the activities were designed and implemented required the teachers to ascribe particular teacher practices and student learning opportunities to only one phase of CMP2 lessons, and the coaches directly suggested that teachers' ideas about the various phases of the lesson were either correct or incorrect.

- Designed the PD session around an upcoming focal lesson. However, it is difficult to discern a specific set of *instructional* practices that the PD was designed to target.

- Designed and enacted activities (i.e. the anticipation guide and Sorting Activity) in ways that reflected an assumption that the purpose of PD is to find and correct deficits in teachers' current practices. The other activities (i.e. the model lesson and the reflective discussion that

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followed the model lesson) were enacted in ways that provided an initial indication of a shift towards providing opportunities for rich discussions about practice.

- Planned activities designed to elicit current teacher perspectives on instructional practices but, in their enactment, these activities framed instructional practices too abstractly to influence the enactment of the other activities in this session or to even substantially influence the design of future teacher PD sessions.
- Varied the quality of their press across activities.

Cycle Two: Coach PD Session II

Goals for Coach PD Session II

In session two, we continued working towards the goals outlined for coach PD session one and added two additional immediate or short-term goals for our work with the coaches. The first immediate goal was that the coaches would view the difficulties that they encountered while leading teacher PD sessions as opportunities to think through how the PD needed to be improved rather than attribute the source of the difficulty to the teachers. In other words, we aimed to support the coaches in developing the reflective practices of considering how the design and enactment of the teacher PD sessions may have contributed to the problems that they encountered.

We conjectured that making progress towards this session goal would support our first long-term goal of viewing instructional improvement as a developmental trajectory rather than as rectifying deficits in teachers' current practices. The "rectifying deficits" view of PD is at odds with the practice of supporting instructional improvement by building on teachers' current

practices. We conjectured that work on this goal would involve supporting the coaches in analyzing how what they, as leaders, do and say during teacher PD sessions may impact what teachers learn, and that this might also support the coaches in coming to view instructional improvement developmentally. Since work on this goal would involve supporting coaches in connecting teacher talk and actions during PD to the design and enactment of the PD, we also conjectured that progress towards this session goal would support our second long-term goal of enabling the coaches to design supports for teachers' learning that were informed by ongoing assessments of teachers' current practices.

We conjectured that discussions of observations from the pilot teacher PD sessions would be a means of support for this session goal. Specifically, we conjectured that viewing clips of the prior pilot teacher PD session and explicitly asking the coaches to share what they thought they did well and where they thought they could improve would support them in attributing difficulties to the design and enactment of specific activities. We also conjectured that providing opportunities for the coaches to design the next pilot teacher PD in light of these reflections would be a means of support for this session goal.

As evidence of progress towards this first session goal, I focused on the coaches' observations about the PD and attended in particular to their reports of difficulties. Specifically I attended to what they shared about what went well and why as well as what could have been improved and how. In addition, I looked for evidence that the coaches' reflections influenced their designs for the next pilot teacher PD session.

The second immediate goal for this session was that the coaches would begin to appropriate a routine for planning teacher PD. This goal builds on the third session goal for coach PD session one. As stated earlier, coach PD session one was the first time that the MIST

research team and the coaches had worked together to plan PD and thus, it is not surprising that

the coaches did not contribute to the co-development of a routine during that session. Again,

during coach PD session two, we planned to initiate the co-development of a routine for planning

teacher PD as a means of support for this goal. As evidence of progress towards this session

goal, I looked for evidence that the coaches were participating in the development of a planning

routine and were appropriating this routine.

In the following section, I outline the extent to which there was evidence the coaches

made progress towards these two session goals.

Supports Provided for Coaches during Coach PD Session II

It is important to note that, based on our then current inferences about what the coaches

learned in coach PD session one, the research team made a few adjustments to the design of the

coach PD. One adjustment was that we omitted the planned discussion of the purposes of the

phases of CMP2 lessons. Based on the discussion during coach PD session one, we inferred at

the time that we had established a sufficient shared understanding of the logic of CMP2 lessons

and did not need to have an additional discussion. Another adjustment was members of the

research team did not model any of the phases of the focal lesson. Though we were working on a

different focal lesson, based on our observations from coach PD session one and the pilot teacher

PD session, we were confident that the coaches did not need to experience another formal

modeled lesson. Instead, we provided opportunities for the participants to solve the task and then

share their different solution strategies as a whole group. We also planned to adjust the second

coach PD session by providing formal opportunities for the coaches to rehearse some of their

facilitation practices. At the time, based on our observations of the first pilot teacher PD, we

conjectured adding rehearsals to the design would improve our supports for the coaches'

development of facilitation practices.

Evidence of Progress towards Goals for this Session

Goal one: viewing difficulties encountered in PD sessions as opportunities to improve the PD design. Recall that we conjectured that viewing clips of the teacher PD and

having explicit discussions with the coaches about what they thought they could improve would

support them in attributing difficulties to the design and enactment of specific activities. I found

that the coaches shared reflections that indicated that they viewed difficulties as opportunities to

improve the design of the teacher PD session. However the extent to which their suggestions

substantially impacted the design on the PD session varied. For example, the following exchange

took place when the coaches reflected on their goals for teachers' learning in the first PD session

that they had led and considered whether their goals were met:

Kara (F):	When you think back to [the pilot teacher PD], what are your assessments of the goals? Like did you meet the goals for teachers' learning?... What about with this one? Understanding the purposes of the 3 phases?
Alice:	I think we did. Um, the activity where they had to sort the different characteristics of the lessons along with the model lesson of what should be happening in those phases, I think that helped. Beause some of our teachers were doing the Explore as a guided practice.
Kara (F):	Okay so one of the misconceptions here is this issue of Explore as- (writing on the dry erase board)
Alice:	Right
Kara (F):	Guided practice

Amanda: Well I think also from when they were sorting and when they were working together, there was a lot of rich discussion on where the cards should go but none of us would tell them yes or no so I think that was for them - they kept on like arguing back and forth and we were like, "well, we'll see". And so when we actually went and they did the containers then they were like "urg, I told you I was right". You know and so I think that was - really there was rich discussion in that area. And so I think for that purpose, I think our goal was met.

Kara (F): For the three phases. And Malcolm?

Malcolm: I was think - there was a lot of discussion in the sorting activities of there were some things they thought could go in two areas instead of just one. Um another thing I was thinking about is our discussion of summarizing a lesson versus closing a lesson.

Kara (F): Mmm, okay. So that might be related to this issue of the Summary here

Malcolm: Yes

Kara (F): Can you say more about that? Like what you-

Malcolm: Um, we were trying to make a distinction between - you know if you were at the end of your period but you hadn't finished the whole lesson, how would you close that lesson but come back to it the next day versus I'm at the very end of the lesson and I'm summarizing and we're going through explaining the math we've learned. How those two pieces are different.

Kara (F): And you felt that teachers were coming to a better understanding of or - how would you characterize that I guess?

Malcolm: I felt as though they - some people left still confused about the two.

Kara (F): So this might be something... to come back to?

Malcolm: Yes.

Kara (F): What were the clues that they were still confused?

Malcolm: Uh, I guess just the - our meaning and their meaning of what it means to close a lesson.

Kara (F): Okay.

Alice: And I think at that point we were running short on time.

Malcolm: Yeah.

Kara (F): Do you think, how about for this particular goal.. do you feel that that goal was met for them?

Amanda: I think for some of the teachers you could tell that the light bulb went off but I'm not sure, I can't say for sure that 100% of the teachers, all 18 of them that were there, took something back. There was no - we didn't get any feedback. I mean it was verbal feedback but there wasn't anything that we could go by. Like data that we could go by to see if it worked, it didn't work, what we need to change.

Alice: So if we did a ticket out the door or something next time.

Amanda: Yeah it was like, okay we did it and so did it work? Did it not? And all we hear is that we did a fabulous job which I don't - (laughs). But you know it's just one of those things that I can't say for certain that every teacher got something out of it. I mean would ya'll agree with that?

Malcolm: I do

In this excerpt, though Alice and Amanda expressed that they thought they had met the goal of supporting teachers in understanding the purpose of the phases of CMP2 lessons, Malcolm indicated that some of the teachers might still have been confused about distinctions between the two different Summaries the coaches had modeled. Amanda said that they had no definite way of knowing for sure whether the teachers were confused and Alice then suggested that they add an exit slip to their design for teacher PD. This suggested change has potential to improve the design and enactment of the PD by enabling the coaches to assess the extent to which the teachers understood the key difference between the two types of Summaries.

In another example of the coaches identifying difficulties and suggesting improvements to the design of the teacher PD, Amanda shared that she was concerned that the reflective discussion that followed the model lesson was too didactical.

Amanda: [I don't want the discussion to be] just from them to us. From them to them and the group or that way. So it's not just me asking the question and having two or three people answer and then ask another question and two or three people - I mean I don't - and that's what I kind of see this doing and that's not what I would like.

Alice: Is that where a Kaegan [or student engagement strategy] would come in [for example] with the Stand up, Hand up, Pair up where you'd throw the question up, they discuss it among themselves. You know how the - you talk for 30 sec and then I talk for 30 sec and then we popcorn [or share out with the whole group] and then go on to the next question.

Amanda: That sounds good.

Alice: It would make it interactive.

Amanda: That's the only -

Alice: And get them up and moving.

Amanda: - that's the only thing about having that reflection piece is having them do more of the talking than me having to ask or, you know.

In this excerpt, Amanda indicated that she was concerned that only two or three teachers actively participated in the reflective discussion. She also noted that the few teachers who participated responded to the coaches' questions rather than engaging in a more genuine discussion as a large group (i.e. the teachers did not talk or respond to each other). Alice then suggested that they use the Kaegan strategy "Stand up, Hand up, Pair up" so that the teachers would talk to each other before having a large group discussion. This suggested revision has potential to improve the design and enactment of the teacher PD by providing additional time for teachers to think through responses to the questions with a partner before reporting out to the larger group.

As a final example, in talking about the Sorting Activity that the coaches had led during the teacher PD, Kara suggested that part of the difficulty the coaches experienced in trying to explain the correct/incorrect placement of the statements was because the coaches and teachers might have had different images of the instructional practices that they were attempting to assign to the Launch, Explore, or Summary. Kara therefore proposed that they change the order of the activities.

Kara (F):   But then one other thought too is, in terms of the ordering, it seems like the anticipation guide was great up front because it was just quick information and then you could use that to check on things and I - one thought was whether or not you want to wait to do the sorting until after they've done the lesson because then they could use that to make sense of-

Alice: Have that moved up to the side?

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Kara (F):   Yeah, like they could make sense of the purposes of the lesson after they've gone through [the focal lesson].

In this excerpt, Kara specifically suggested that the coaches reorganize the PD so that the Sorting Activity occurred after the model lesson. She justified this suggestion by stating that the teachers could better make sense of an activity about the logic of CMP2 lessons after experiencing a well-implemented lesson.

The coaches then responded to Kara's suggestion.

Amanda: (Looking over Malcolm's shoulder at his laptop which is displaying the PowerPoint they had created for the first teacher PD) What we could probably do with that [slide of the Sorting Activity]. If we ended up waiting until the end -… one (slide) per - like one for Launch, one for Explore, one for Summary. But then you're gonna have to make [the statement texts]bigger so they can read them. Because they couldn't read 'em.

Malcolm: Yeah, because that was the issue was trying to fit them all on there and it was too - yeah too much.

Amanda: We could use the whole entire [slide]. The others don't need to be on there -

Alice: Yeah, go horizontal instead of vertical

In this excerpt the coaches responded to Kara's suggestion by suggesting that they instead make a design change to the Sorting Activity slide in order to help make statements more legible. Specifically, Amanda suggested that they create a separate slide for each phase (Launch, Explore, Summary) because the text for the statements was small and difficult for teachers to read. Malcolm added that the problem was that they could not fit everything on the screen, and Alice suggested that they arrange the boxes horizontally rather than of vertically.

Amanda then returned to Kara's original suggestion:

Amanda: (Looking at Kara) So are you saying to pretty much start off with the lesson and then do everything at the end?

Kara (F):   I'm wondering, I mean that's one way to go because then you could refer back to it the whole time and say - like if someone says - you know when they were like - I'm trying to think of an example where one of the teachers' questions about, "I'm not sure where this goes" or whatever

Amanda: Yeah they wanted it kind of like in the middle

Kara (F): Yeah and that could - I mean I guess you could do it other ways too. You could say okay I mean we could have that discussion about the middle but also say "okay let's think back to what Alice was doing in there" as one way so that they're all referring to the same thing. But I don't know.

In this excerpt, Kara re-emphasized her suggestion to model the lesson before the Sorting Activity in order to support the teachers in thinking through the learning opportunities in each phase of the lesson. She stated that reorganizing the activities in this way would provide teachers opportunities to refer back to concrete examples or experiences from the model lesson when they participated in the Sorting Activity. In addition, she suggested that this approach may support the teachers in contextualizing the statements in the Sorting Activity.

Amanda then responded by voicing her concerns about Kara's suggestions.

Amanda: …My only thing with doing that, we want to - I think we want to drive the whole Summarization piece and I think - well I don't know - I think if we

Alice: You think it would take away from it?

Amanda: Yeah, after that piece.

Kara (F): If you do it after that piece. Okay, that's interesting.

Amanda: So we're kind of introducing the three cycles of the lesson, talking about the importance of all three, and then we're doing it, and then we're really narrowing in.

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(Alice agrees and notes that this talk about the three phases will be new for some teachers attending the upcoming PD because they work in schools that did not send any teachers to the first teacher PD session. Malcolm and Amanda clarify that since the upcoming PD will be for a totally different grade-level, it is highly likely that talk about the logic of the lesson will be new to all of the participants)

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Kara (F):   No, I see what you're saying though about that's the point that you're trying to hammer home.

Alice: I think it needs to stay in the front then.

Amanda: Yeah, they could still do the cards and then we could do four corners instead of the conatiners because it's hard to read the containers. Even though I love the idea, but it was really hard for them to see.

Amanda did not pick up on the rationale for Kara's proposal and ultimately pushed back saying, since the focal phase for these teacher PD sessions was the Summary phase, she thought it would be more sensible to discuss the purposes of all three phases and then narrow in on the Summary. Kara said she saw Amanda's point and they moved on.

It appears the coaches continued to view their original design for the Sorting Activity as sound. Their suggested revisions to the Sorting Activity focused on surface-level aspects and did not improve or problematize underlying assumptions inherent in the design of the activity. Specifically their revisions did not address the fact that their design treated the lesson phases as discrete and that the design made it necessary for teachers to talk about instructional practices in the abstract. Thus the coaches did not see a need to support teachers by grounding the Sorting Activity in a modeled lesson as Kara suggested.

Moreover, the coaches did not question the underlying assumptions of the Sorting Activity even when Kara pushed them and suggested an alternative. These assumptions included that certain student learning opportunities happen in specific phases of CMP2 lessons and that it is simply a matter of getting teachers to see this. Another assumption is that the teachers and the coaches had a shared understanding of the logic of CMP2 lessons and shared images of the instructional practices described in the statements. Thus the issue of how teachers might

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understand the lesson phases and the instructional practices did not arise for the coaches despite Kara's suggestions.

Adding an exit slip to the teacher PD design in order to assess the level of teachers' understanding and increasing teacher participation during whole group discussions by first providing opportunities for teachers to discuss questions with each other are clearly more substantial improvements to the design of PD than rearranging the boxes in the Sorting Activity. Moreover, the proposed change of adding an exit slip makes sense in terms of supporting teachers' learning because teachers' responses could inform the design of subsequent teacher PD sessions. Similarly, the proposed change of providing opportunities for teachers to discuss questions with one another prior to the whole group discussion makes sense because it could support their participation in the whole group discussion.

In the last example, it appeared that the coaches and the research team attributed difficulties with the Sorting Activity to different sources. On the one hand, the coaches attributed the difficulty to the logistical issues teachers had in operating the SmartBoard and to the size of the text in the boxes. The research team, on the other hand, attributed the difficult to possible differences between the teachers' and coaches' images of the practices being discussed.

I conjecture that if the research team made more of an effort to develop a shared understanding of the sources of difficulty with the coaches, we could have better supported them in improving the design and enactment of their pilot teacher PD. Specifically, the research team pointed to structural issues in the order of the activities whereas the coaches attributed the difficulty to a less fundamental issue, the formatting of the screen. Moreover, I conjecture that in the future, adding an explicit goal about developing *shared understandings* of the sources of difficulties could improve the design of this type of work with coaches (i.e. it was not just that

the coaches need to view difficulties as opportunities to improve PD: there also needed to be an explicit focus on identifying and agreeing on the sources of these difficulties). This has implications for the design of work with coaches. For example, in another iteration of this type of work with coaches, when there is agreement that an activity was problematic the first question that should be posed is *why* was the activity problematic. Then, after agreeing and developing shared understandings of the source of the problem, the question of *how* would you improve the design of the activity should be posed.

Recall we conjectured that making progress towards this session goal would support our first long-term goal of viewing instructional improvement as a developmental trajectory rather than as rectifying deficits in teachers' current practices. One intent of providing opportunities for the coaches to share difficulties and to suggest ways to improve the teacher PD was to enable us to assess the extent to which the they were making connections between what the teachers said and did during the PD and the coaches' design and enactment of the PD. Viewing instructional improvement developmentally involves coming to understand that part of the work of supporting instructional improvement is continually assessing and re-assessing teacher practices and adjusting supports for teacher learning accordingly. Thus, we conjectured that supporting the coaches in making direct connections between what teachers were learning in their sessions and the design and enactment of these sessions would be an important step in supporting coaches to view instructional improvement developmentally. I have highlighted evidence that the coaches did, on occasion, make contributions that demonstrated that they were connecting teacher actions during PD to the design of the PD, though the significance of these connections varied.

In addition, there was an instance when the coaches explicitly shared reflections that indicated that they were at least beginning to reconceptualize instructional improvement as a

developmental trajectory (rather than as rectifying deficits). While planning for the upcoming

teacher PD, the coaches acknowledged that they were currently supporting teachers in

understanding the learning opportunities that could arise for students in the Summary phase, but

mentioned that incorporating a discussion about *planning* for the Summary would be good for a

future PD session.

> Amanda: So here we're trying to get them to have value in the Summarize piece but we're also wanting them to be able to take it and actually [collaboratively plan a lesson] with other teachers. Because we're just modeling the lesson and what happens in the classroom not the pre-planning - that's like a whole other PD.
>
> Kara (F): Yeah, it's like another PD. It's like you're figuring out what's the benefit of Summaries - Why is the Summary so important? Is kind of like what you're doing with this. Yeah, but not -
>
> Amanda: Maybe we need to compose another PD of "show-and-tell lesson planning"?
>
> Alice: Well calendaring.
>
> Amanda: Calendering, but there's also show-and-tell. That's what I witnessed yesterday.
>
> Alice: But that could be the next pull out [or formal teacher PD session] for the spring semeseter is - You know the first pull out [or formal teacher PD session] - this was the introduction of the Summary and then the second semester would be "Okay we've shown you what it's supposed to look like, how can we get this in your discussions for your planning?"
>
> Malcolm: And it's just like what I was thinking with the group of teachers we did it with last time, would they have been ready at that point to plan a lesson?
>
> Kara (F): Right.
>
> Alice: No. They were overwhelmed at that point.
>
> Malcolm: So that may not be something we need to focus on this time.
>
> Amanda: Yeah no. I'm with you on that.

In this excerpt, Amanda suggested the need for an additional teacher PD session on the "pre-

planning" involved in preparing for the Summary phase. Alice agreed and explicitly calendared

the progression for teachers (i.e. this semester/session is an introduction to the Summary phase

and what it should look like, and next semester/session should be about the necessary planning

for such a Summary). Malcolm concurred and emphasized that the teachers would not have been "ready" to talk about planning so it was better that they held off and would be focusing on planning for the next teacher PD session.

These contributions from the coaches indicated that they were beginning to outline a progression of goals for teachers' long-term learning and viewed the PD sessions as a sequence of linked activities. Though the coaches did not formally call their progression of goals for teachers an "instructional improvement trajectory", they indicated that they were only aiming to support the teachers in developing an image of a high-quality Summary. They also recognized that it would be premature to also try to support teachers in developing an image of planning for a high-quality Summary and instead suggested that this be the focus of the next teacher PD session. Through these reflections, the coaches indicated that they were beginning to conceptualize instructional improvement as a developmental trajectory.

We also conjectured that making progress towards this session goal would support our second long-term goal of enabling the coaches to design supports for teachers' learning that were informed by ongoing assessments of teachers' current practices. Our intent in providing opportunities for the coaches to discuss the difficulties they encountered and to suggest ways to improve the teacher PD was to support them in developing the reflective practices necessary to design supports for teachers based on teacher practices. However, I have presented evidence that indicates that the coaches also needed opportunities to discuss why the difficulties were encountered (i.e. though there is evidence that the coaches made contributions that demonstrated that they were developing such reflective practices, the extent to which these reflections resulted in potential improvements to the design of PD varied).

Goal two: appropriating a routine for planning teacher PD. We conjectured that the coaches would participate increasingly substantially in and eventually appropriate a routine for planning teacher PD initiated by the facilitators. I found that only the facilitators actively contributed to and spoke explicitly about the planning routine. At the start of this session, Paul briefly mentioned that the goal of the collaborative work we were doing with the coaches was to support them in not only planning the upcoming teacher PD, but in developing routines for planning any PD designed around a focal lesson. However, throughout the session, only Kara made suggestions about the sequence of issues that should be addressed when planning PD.

It is important to note that the facilitators did not outline the routine, name aspects of it, or initiate a discussion of the process of planning teacher PD. As a consequence, it is not clear that the coaches perceived what we were doing as a routine. I conjecture that in future work with coaches, supporting them in stepping back and reflecting on the planning process and supporting them in outlining the process would better support them in contributing to the ongoing development of PD planning routines and in appropriating such a routine.

During this session, we spent a considerable amount of time rehearsing and thinking about the model lesson. However, because the coaches were expert teachers, this is the one aspect of their design that we could have trusted that they enact effectively. I conjecture that if we had spent more time thinking about and rehearsing the more problematic parts of the PD (e.g. the Sorting Activity) then we could have better supported the coaches in developing an understanding of why these activities may have been problematic (beyond the technical difficulties). This observation has implications for the design of work in the future, an issue that I will discuss in detail later.

Summary

During this session:

- The coaches' reflections on the difficulties they encountered during the prior teacher PD session indicated that they viewed difficulties as opportunities to improve the design of the teacher PD session, though the extent to which their suggestions substantially impacted the design of the PD varied.

- The coaches made contributions that demonstrated that they were developing the reflective practices necessary to design supports for teachers that build on teachers' current practices (e.g. occasionally they connected teacher actions during PD to the design of the PD).

- The coaches did not contribute to the development of a planning routine nor was there evidence that they were appropriating aspects of the routine. In fact, there was no evidence that the coaches perceived our collaborative work as a routine.

Cycle Two: Coaches' PD Facilitation Practices in Pilot Teacher PD Session II

Twenty-three days after the second coach PD session, the coaches co-led the first of five pilot teacher PD sessions that were all video-recorded. This teacher PD was designed to support the 7th grade teachers in planning and teaching a lesson on comparing fractions. Because of the need for quick turnaround, members of the research team watched the video-recording of only the first teacher PD session. For this reason, in the following section, I will only describe the coaches' facilitation practices in this session, and consider the extent to which the coaches made progress towards the goals for coach PD session two as well as the three long-term goals. I also attend to the extent to which the coaches developed unproductive or unintended practices as a consequence of the coach PD session.

Evidence of Progress towards Goals for the Second Coach PD Session

Goal one: viewing difficulties encountered in PD sessions as opportunities to improve the PD design. Recall that while planning the second teacher PD session (during the second coach PD session) Alice suggested that the coaches incorporate an exit slip as a means for addressing Malcolm's concern that the teachers might have been confused about the differences between the two Summaries. The coaches subsequently added an electronic poll (Poll Everywhere) as an exit slip at the very end of the second teacher PD session. Teachers used their phones or computers to anonymously submit their responses to the question, "When you get back to your classroom, how will the discussion we had today impact your instruction?" The website the coaches used for the poll displayed the results in real-time.

Unfortunately, at this point in the teacher PD the coaches were running short on time so they did not share or discuss any of the teachers' responses. Moreover, the question the coaches posed in their exit slip is not effective for assessing the extent to which teachers understood the differences between the two Summaries. The question focused on how the teachers planned to apply what was discussed rather than whether the teachers could make distinctions between the two types of Summaries. Unfortunately, it is not possible to determine why the coaches chose to pose that question as their exit slip.

Recall that Alice suggested adding a Kaegan strategy to provide opportunities for teachers to talk to one another before sharing with the large group as a means of attending to Amanda's concern about low teacher participation during the reflective discussion. The coaches designed a "compare and contrast matrix" (see Figure 4) as a means of organizing the teachers' thoughts about the instructional practices and learning opportunities in a show-and-tell discussion and in a more genuine Summary. The coaches also added *Closure* as another "type"

of Summary (according to the coaches, when students do not have time to completely finish a task teachers must still "close out" the lesson by summarizing the lesson in a Closure).
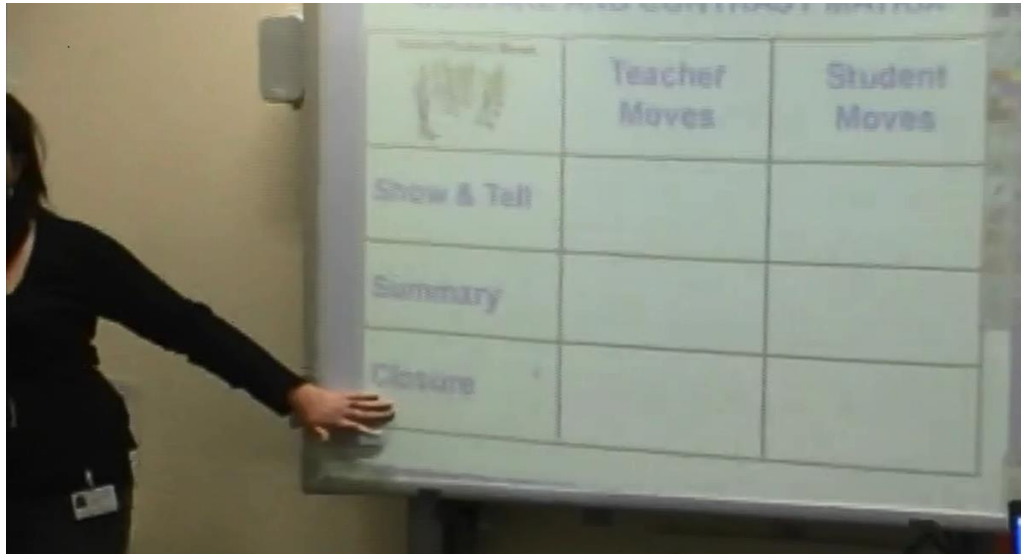
Figure 4: Screen shot of Amanda talking through how to set up and interpret the "compare and contrast matrix".

The coaches directed the teachers to each create this matrix and to discuss in small groups what they remembered the teacher and students doing in the modeled Summaries. Next, they directed the teachers to partner with a teacher not in their small group and share their conclusions. Then Malcolm facilitated a reflective whole-group discussion.

The reflective discussion did appear to be richer than that in the first teacher PD session. Specifically more teachers contributed and there was more teacher-teacher talk. For example, in response to Malcolm's question about what was lacking in the show-and-tell Summary, the following exchange took place:

MT3:   I was just going to say during the show and tell you have all of these students showing all of this stuff and just show and tell without the teacher making the connections because in the Summarization, for me, the teacher started making connections - of course, clarified misconceptions as we said, but helped me to see the different ways that [the different representations] are connected. For me, when I saw the show and tell, I walked away very confused going, "Wait a minute, that looks like the small [group] is the better deal". Well I got that clarified for me. So you know

Malcolm: How did you get clarification in the other Summary? Who clarified it for you? What clarified it for you? What was done to clarify that misconception for you?

FT11:   You started to see the different strategies... they were presented in different ways but -

Malcolm: Who presented them?

FT11:   The students started presenting in different ways in my opinion. From what I saw. (Turning and talking to the other teacher participants) Or was it the teacher? Who was it? I don't remember.

Choral: Nobody... they just said it and left it

(multiple Ts at once)

In this excerpt, the teachers spoke explicitly about differences they saw between the show-and-tell and the more genuine Summary (e.g. MT3's discussion of his confusion in the show-and-tell versus the clarity and connections made in the Summary).

Immediately following the choral response, Malcolm continued to facilitate the discussion:

Malcolm: So in the show-and-tell it was just stated and that was it -

F11:   Right.

Malcolm: - but in the actual Summary who explained?

MT3:   The teacher kind of articulated, for me

F11:   …I thought he was asking in the Summary phase

Malcolm: Yeah in the second Summary where we saw the different representations, who explained all of this work?

FT18:   The students.

FT11:   The different people who did it, the students

Malcolm: The students?

FT1:   The students explained it but the teacher clarified what they really meant

FT13:   See I thought the teacher explain it and then she kind of asked for clarification

FT11:   No, what I heard - I heard the students explaining what they had put on their problems and the teacher just clarified what her understanding of -

FT7:   Right.

FT11:   - what the students had done.

FT7:   Right.

Malcolm: Okay, I heard a "right" over here (pointing to FT7)

FT7:   Because I feel like over here (pointing at the work from the genuine Summary on the front wall) the teacher did, you know, make these connections here by "okay we need to start labeling things so that we know what is what". And the same thing over here (point at the side board where Malcolm's work was left from the Show-and-Tell model Summary) with that. Because I'm totally with you [MT3]. I did not - you know, I wasn't here for that but I'm looking at it now and I don't understand why you have 2 1/2 and that looks like 2 2/3. You know. And again, you can't divide people, you'll go to jail.

Choral: (laughs)

(all Ts at once)

Malcolm: So and it kind of goes back to that part that we just did with Amanda. In that in the real Summary, where we saw the multiple representations what was the role of the student? What was the role of the teacher? And how did those two come together? And what was the reason for needing those two to come together?

In this excerpt, Malcolm asked questions about the teacher's and students' participation, which supported the teachers in highlighting differences in the show-and-tell and in the more genuine Summary. Thus, the matrix the coaches had designed appeared to support productive discussions about distinctions between the two Summaries, including differences in how the teacher and students interacted. In addition, the opportunity to talk through their observations in small groups and with partners may have helped the teachers feel comfortable sharing during the whole group

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discussion. Specifically, the teachers built on and challenged each other's contributions (e.g. the exchange between FT11 and FT13; also FT7's link to MT3). The matrix coupled with the Kaegan strategy appeared to improve the overall quality of the reflective discussion.

Last, recall that Amanda and Alice suggested modifying the actual slides they used for the Sorting Activity to address the difficulties they had experienced while facilitating this activity. The coaches did not make a separate slide for each phase nor did they change the boxes from vertical to horizontal. Instead they made the boxes a little wider and made the statement textboxes narrowed so that teachers could fit the statements in the boxes for the lesson phases more easily. They also added a "gallery walk" component to the Sorting Activity. Prior to facilitating the Sorting Activity as a large group, the coaches posted the statements from the Sorting Activity around the room and had three different colors of papers represent each of the lesson phases under each statement. They had the teachers partner up and walk around the room with post-it notes. The teacher pairs were told to read each statement, decide under which phase each statement belonged, and stick the post-it on the corresponding colored paper (see Figure 5). After this gallery walk, the coaches led the teachers through the Sorting Activity at the SmartBoard using the same statements that were posted around the room.
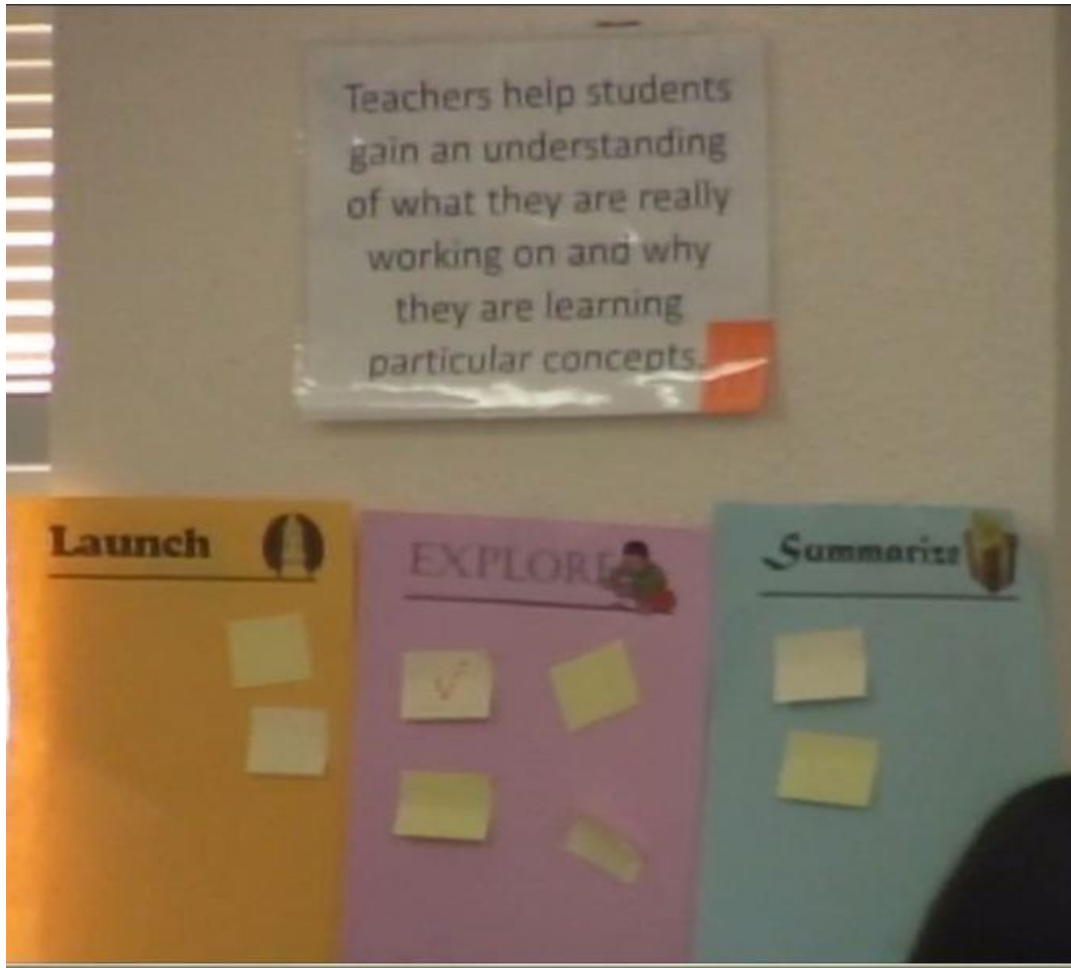
Figure 5: Screen shot of a Sorting Activity statement and post-it notes that recorded the teachers' sorting decisions during the gallery walk.

Other than these changes, the Sorting Activity at the SmartBoard occurred the same way as it had during the first pilot teacher PD session. However the gallery walk assisted the coaches in assessing the extent to which the teachers were on the same page in terms of the relationship between instructional practices and the phases of the lesson. In addition, Amanda, the coach who facilitated the Sorting Activity, consistently referred to the teacher responses from the gallery walk and used the responses to press on the teachers' contributions. For example, the following exchanged occurred during the Sorting Activity at the SmartBoard while a teacher volunteer

(FT12) decided where to put the statement: "Teachers question students to monitor where they

are and push their thinking further".

> Amanda: So that's over here (in the back of the room, where this statement was located during the gallery walk). Everyone put Explore. Are you okay with Explore?

> FT12 (moves the statement text to the "Summary" box where it is accepted, indicating that the statement belongs in the Summary phase)

> Amanda: Alright. That one we are gonna have to spend some time talking - it says, "Teachers question students to monitor where they are and push their thinking further". What do ya'll think? Everybody that read that statement said it was under the Explore but [the SmartBoard] says it's under Summary. So what do you think?

> MT7: I can go with that.

> Amanda: Okay, he says he can go with that. Why is that?

> MT7: Because you're questioning what kids are picking up along the way and then you use that information to keep questioning them at a higher level. So you basically just keep asking questions because they've got this and now you want to see if they really got it.

> Amanda: Yep absolutely. Anyone else? Disagree? 'Cause - are we all good now that it goes with the Summary?

> FT1: I don't see why it can't go in both.

> Amanda: Okay explain. She says it could be in both. Why?

> FT1: Because a lot of times you'll have groups who aren't there yet and so you do have to question them to see where they are and to push them a little bit further to get them to where you want them to go so that they can actively participate in the Summary.

> Amanda: Okay. Anyone else?

In this excerpt, Amanda saw that all of the teacher pairs had originally put the statement under

the Explore phase during the gallery walk by surveying the placement of the post-its. When

placement on the SmartBoard indicated that the statement belonged in the Summary phase,

Amanda asked the teachers to share their thoughts and pressed for explanations.

Amanda consistently referred to the gallery walk responses and pressed teachers to justify

their contributions throughout the Sorting Activity, which was an improvement when compared

with the facilitation of the first teacher PD. In addition, Amanda encouraged teachers to respond

to "correct" answers and entertained the possibility that statements could belong in multiple

phases of the lesson. For example, the following exchanged occurred when a teacher volunteer

(MT8) was at the SmartBoard deciding where to put the statement: "Teacher clarifies

misconceptions".

Amanda:	Okay so again that's a split - Explore, Summary
MT8	(moves the statement text to the "Summary" box. The statement is accepted, indicating that the statement belongs in the Summary phase)
Amanda:	Summary! Okay I see some - before we do a celebration, I saw a bit of confusion on some faces. Was that a shock? What do you think? Can it go in both? Can it go under Explore and Summary?
Choral:	Yeah...I think so...(nods)

(multiple Ts at once)

Amanda:	I see you guys nodding, can you explain why?
FT8:	I mean if I have kids that are completely going down the wrong route - well I'm not going to let them waste 45 minutes before I try to guide them back on the right track.
Amanda:	Mmm, alright. So you're saying that it could go to either one?
FT8:	Yeah
Amanda:	Okay, perfect.

In this excerpt, Amanda again surveyed the gallery walk responses and determined that the

teachers' responses were split between the Explore and the Summary phases. After placement on

the SmartBoard indicated that the statement belonged in the Summary phase, Amanda detected

that there was confusion. She then asked the teachers if it could belong to both Summary and

Explore, and accepted the argument of a teacher volunteer (FT8) who justified why it belonged

in both.

There appeared to be significant improvements in the facilitation of the Sorting Activity in this second pilot teacher PD. Specifically, Amanda consistently pressed for justifications and accepted that statements could belong to multiple phases. However, the changes the coaches made in the design of the PowerPoint slide and even the addition of the gallery walk beforehand did not appear to address some of the problematic aspects of the activity. Namely, the SmartBoard was still set up so that a statement could be assigned to only one lesson phase, indicating that there was only one right answer and that the phases of CMP2 lessons were discrete (which again is at odds with the intent of the curriculum). In addition, although the coaches elicited teachers' understandings of the three phases of CMP2 lessons and consistently pressed on teachers' contributions, they did not follow-up after any of the teachers' justifications. In other words, the coaches appeared to be satisfied when teachers explained their responses and just moved on rather than pushing back or intentionally prompting other teachers to respond to the teachers' justifications.

Goal two: appropriating a routine for planning teacher PD. Recall that the second goal for the second coach PD session was that the coaches would co-develop and appropriate a routine for planning teacher PD. As was mentioned earlier, the coaches did not adopt the routine for planning teacher PD. However, the coaches appeared to be developing a routine for *enacting* teacher PD. Specifically, they started teacher PD sessions by leading an activity designed to elicit teacher perspectives of the phases of CMP2 lessons. Then they prompted the teachers to examine a specific lesson and discussed the goals for the unit in relation to the goals for the specific lesson. Next, they modeled the focal lesson before finally leading a reflective discussion of the Summary/Summaries (the focal phase) of the modeled lesson. Although there was room for improvement in the design and enactment of these activities, the fact that the coaches followed

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this same enactment routine for pilot teacher PD sessions one and two demonstrates that they viewed these as productive activities in which to engage teachers.

I conjecture that we could have better supported the coaches in co-developing and appropriating a planning routine by outlining and naming aspects of their enactment routine, and then deliberately making connections between this routine and the routine for planning upcoming teacher PD. This could have implications for the design of work in the future, an issue that I will discuss in detail later.

Evidence of Progress towards Long-term Goals for Our Work with the Coaches

Overall goal one: developing views of instructional improvement as a developmental trajectory rather than as rectifying deficits. Our first overall goal for our work with the coaches was to support them in coming to view their role in PD leadership as supporting teachers' development of improved instructional practices, rather than as simply identifying and attempting to "fix" deficits in their current practices. In reviewing their second pilot teacher PD session, I found evidence that the coaches continued to design and enact activities that reflected the assumption that the purpose of PD is to find and correct deficits in teachers' current practices. For example, after the sorting activity and before the model lesson, Amanda led the group through a "Poll Everywhere" poll. In framing the poll activity, Amanda said:

> Amanda: Okay thank you very much. What I would like for you to do - I'm going to check whether you guys understand it or not so you need to have you cell phone out or you could use your wi-fi device, your laptop would be fine. But you're gonna text an answer in for me. Actually two. This is called PollEverywhere.com and so I'm just gonna do a little formative assessment to see if we are all on the same page.

In this excerpt, Amanda explicitly told the teachers that she was using the poll as a way to check for understanding/a formative assessment. She also said she wanted to see if they were all "on

the same page". The language used in her framing of this activity reflected that the purpose of this activity is to assess the extent to which there are deficits that need to be addressed.

After displaying the two poll questions and giving the teachers adequate time to submit their responses, Amanda quickly went over their responses with the whole group.

Amanda: So I have 14 people. Just real quick, the first - this one (pulls up the PollEverywhere page with the first question and the teachers' poll results), "Which phase of the lesson cycle is most significant for learning to take place?" Yes [learning happens] in all of them. And that's something we'll continue whenever we do the modelling in the second part [of this PD session]. So that way you can keep that in mind. But it is in every part of the lesson cycle there's learning taking place. And then the other one, the true and false, we were kind of split on that one (switches to the page with the second question and poll results). "Teachers should guide students through the task before students are given time to work on it". And that would be - the majority is correct. 75% [of you selected and] it is false. Guiding would be you telling them exactly how to do it, step by step by step. Okay? Alright. Next thing!

The way in which Amanda reviewed the polling results positioned certain teachers as being correct and others as incorrect. For example, in going over the second question, the 75% of the teachers who selected false were told they were correct and by default, the 25% who selected true were told they were incorrect. And instead of using this discrepancy as a starting place for a discussion in which teachers are given opportunities to share their thoughts, push back on each other's ideas, and justify their contributions, Amanda told the teachers that the majority of them were correct and moved on to the next activity, which is consistent with the assumption that the purpose of PD is to identify and correct deficits.

As I mentioned earlier, the coaches also used a second PollEverywhere poll as an exit slip at the end of the PD session. This poll gave teachers an opportunity to submit open-ended responses. However, the poll that immediately followed the Sorting Activity was multiple-choice. Though it may have surfaced teachers' understandings of the lesson phases, the way Amanda reviewed the poll indicated to the teachers that their ideas about the various phases of

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the lesson were correct or incorrect (which reflects the assumption that the role of PD leaders is to find and correct teacher deficits).

Overall goal two: designing supports for teachers' learning informed by ongoing assessments of teachers' current practices. The second overall goal for our work with the coaches focused on supporting them to design and enact PD based on teachers' current practices. In this second pilot teacher PD, the coaches planned activities designed to elicit current teacher perspectives on instructional practices but framed instructional practices too abstractly to inform the enactment of this or future teacher PD sessions. The coaches did not change the design or enactment of the anticipation guide at all. However, they did alter the Sorting Activity by adding the gallery walk component before the Sorting Activity and the two PollEverywhere questions after the Sorting Activity. These additions appeared to improve the extent to which teachers shared their understanding of the instructional practices being discussed. These additions also made it easier for the coaches to assess the extent to which the teachers were all on the same page. However, despite these modifications, the redesigned activity did not support the development of shared images of the instructional practices being discussed. Thus, talk about teacher practices remained abstract and was not likely to influence the enactment of teacher PD in the future.

Overall goal three: facilitating teacher PD by pressing on teachers' ideas differentially. The third overall goal for our work with the coaches was to support them in facilitating teacher PD by building on teacher contributions. I found that the quality of the coaches' press again varied across activities. For instance, the coaches still did not press when they enacted the anticipation guide. However, as described above, Amanda did press differentially on teacher ideas during the Sorting Activity and Malcolm continued to respond to

teachers' ideas differentially as he facilitated the reflective discussion that followed the model lesson.

Summary

During this pilot teacher PD:

- The coaches did appear to view difficulties encountered in PD sessions as opportunities to improve the PD design. However there were inconsistencies in the extent to which the changes to the PD design were likely to alleviate difficulties.

- Though the coaches may not have yet appropriated a routine for planning teacher PD, they appeared to be developing a routine for *enacting* teacher PD.

- The coaches continued to design and enact activities that conveyed to the teachers that their ideas about the various phases of the lesson were correct or incorrect.

- The coaches continued to design and enact activities that elicited teachers' current *understandings* of instructional practices, but talk about instructional *practices* was still too abstract to influence the enactment of this or future teacher PD sessions.

- The coaches' press continued to vary across activities.

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Cycle Three: Coach PD Session III

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Goals for Coach PD Session III

In session three, we continued working towards the goals outlined for coach PD sessions one and two, and added one additional immediate or short-term goal. The immediate goal was

that the coaches would look beyond the upcoming teacher PD session, and view the coach PD session as a context to work on their practices in planning and leading PD more generally.

Work on this goal involves supporting the coaches in thinking about what they were doing while planning and leading the teacher PD sessions that they could take and apply to planning and leading teacher PD more generally (notwithstanding the specific content of the focal lessons). In other words, work on this goal entailed reflecting on our collaborative ways of working together and the routines we were developing. We conjectured that making progress towards this session goal would support the second immediate goal for coach PD session two, which was that the coaches would begin to appropriate a routine for planning teacher PD.

We also conjectured that this goal would build on the third session goal for coach PD session one, which was that the coaches would learn to design teacher PD sessions that aimed to support teachers' development of particular instructional practices and were organized around specific upcoming lessons the teachers would teach. Supporting the coaches in working on their PD planning and facilitation practices more generally by developing routines would support the coaches in designing and enacting teacher PD organized around *any* upcoming lesson that teachers may teach. In other words, we conjectured that the coaches would appropriate the routines and ways of working together that we were developing and use them when planning and enacting teacher PD in the future.

As stated earlier, it is not surprising that the coaches did not contribute to the co-development of a routine during coach PD session one as this was the first time that the MIST research team and the coaches had worked together to plan PD. During coach PD session two, there was no evidence that the coaches perceived our collaborative work as a routine. However, although members of the research team made suggestions about the sequence of issues that

should be addressed when planning PD, they did not outline the routine, name aspects of it, or initiate a discussion of the process of planning teacher PD. During this third coach PD session, we again planned to support the co-development of a routine for planning teacher PD. We also explicitly included an opportunity to step back and reflect on the teacher PD planning process as part of the written agenda.

In assessing progress towards this session goal, I looked for evidence that the coaches were participating in the development of a planning routine and were appropriating this routine. Specifically, I looked for instances in which one or more of the coaches took initiative in making suggestions about the sequence of issues that should be addressed when planning PD. I also attended to who explicitly talked about the planning process. In addition, I looked for indications that the coaches were actively participating in the outlining of a routine and in the naming of aspects of the routine.

In the following section, I outline the extent to which there was evidence the coaches made progress towards this session goal.

Supports Provided for Coaches during Coach PD Session III

It is important to note that for the third round of teacher PD the Director and Specialists selected a focal CMP2 *unit* on adding and subtracting decimals that was known to be difficult for teachers to teach (opposed to a focal *lesson*). The Director and Specialists had selected it because they had noticed that teachers often skip straight to the last lesson that focused on developing formal algorithms. In light of this change, the research team adjusted the third coach PD session by providing formal opportunities for the coaches to discuss the goals for student learning across the unit as well as the goals for student learning within each of the individual lessons.

In the third coach PD session, the research team again provided opportunities for the coaches to reflect on and discuss the difficulties that they had encountered while leading the prior teacher PD. We also provided opportunities for the participants to solve tasks within the unit and then share their different solution strategies as a whole group (rather than formally model the unit or lessons within the unit). The research team planned to modify the design of the third coach PD session by providing formal opportunities for the coaches to outline a process for planning teacher PD and name aspects of a routine. At the time, based on our observations of the first two coach PD sessions, we conjectured adding explicit discussions about the planning process would improve our supports for the coaches' development of productive PD designing practices.

Evidence of Progress towards Goal for this Session

Goal: viewing the coach PD session as a context in which to work on planning and facilitating teacher PD more generally. Recall that we conjectured that reflecting on how we worked together and on the routines we were developing would support the coaches in developing routines for planning and leading teacher PD in general. Although we deliberately included time for discussing the planning process in the agenda (see Figure 6), only the facilitators actively contributed to and spoke explicitly about the planning routine.

Top-Level Agenda (times are approximate)

9:00-9:10	Welcome & goals for today
9:10-10:10	Debrief last PD Sessions: Identifying strengths and areas to build on Sense of Urgency
10:10-10:20	Break (10 minutes)
10:20-11:30	Examining CMP2 Investigation, 6th Grade Investigation *Bits and Pieces III, Decimals-More or Less*
11:30-1:00	Break for Lunch
1:00-3:00	Planning PD focused on this unit Step back and reflect on the planning process

Figure 6: Top-level agenda for coach PD session III (taken from the planning documents).

At the start of the PD session, Paul mentioned that the last activity of this session would involve taking a step back and naming aspects of the planning process. However, again only Kara made suggestions about the sequence of issues to be addressed when PD planning throughout the session, and none of the facilitators initiated an actual discussion of the planning process.

One reason for this oversight may have been due to the change from planning for a unit rather than a single lesson. During the session, the coaches and the facilitators spent a lot of time working on some of the tasks, discussing the goals for students' learning for each of the lessons in the unit, and thinking about which (if any) lesson(s) the coaches should model and why. These were all important activities for the coaches to participate in while planning for the upcoming teacher PD session designed around the unit, but they took more time than we had originally anticipated. Thus, the session ended before the facilitators could get to that final agenda item. I conjecture that in future work with coaches, we should explicate the routine during the first two sessions and then move this work of articulating the planning process to the beginning of the

agenda for session three. By naming aspects of the routine at the end of the second session, the routine would be grounded in the actual work of PD planning. By outlining this planning process at the beginning of this third and final session, we could better support the coaches in perceiving what we were doing as a routine, in contributing to the ongoing development of the PD planning routine, and in appropriating such a routine (which was the second immediate goal for coach PD session two).

As I mentioned earlier, during this third coach PD session we provided opportunities for the coaches to reflect on and discuss the difficulties that they encountered while leading the prior teacher PD. It is important to note that the only substantial issue raised was again about the Sorting Activity (other issues raised included the pacing of the activities because the coaches ran out of time, being more deliberate in marking transitions from one activity to the next, and being more strategic in ordering the solution strategies for the discussion they facilitated during the model lesson). The facilitators (Kara and Paul) reiterated Kara's suggestion about facilitating the Sorting Activity after modeling a lesson. This time one of the coaches, Amanda, responded in a way that indicated that she saw what they were highlighting as being problematic about the activity.

While reviewing a clip of Amanda leading the Sorting Activity during the previous teacher PD, the following exchange took place:

Kara (F):   We were just looking at that [clip] in part to try and raise, I guess two issues. One is to kind of go back to what we were just saying before this clip, is that if you have that conversation after Alice had [modeled the lesson], you could have gone back to what she was actually doing and thinking about "well when was Alice pressing on your reasoning?" And it might have been that there was a group that was -

Paul (F):   And "why was she?"

Kara (F):   Yeah and why? Yeah.

Amanda: Oh, so almost like maybe doing [the Sorting Activity] after, like maybe even starting the whole thing with the model teach.

Alice: Yeah right as you walk in -

Amanda: That way you have something to refer back to. That makes sense.

Paul (F): I was just thinking about if I was one of those teachers. I was thinking the teacher from up the camera that was on the right who said, "Well we put it in the middle because" and then the because was, "because when I teach right now, if I have a group who is getting ahead or finishes quickly"- All they [the teachers] can do, the only material they've got to work with is how they currently teach. But that's exactly what you're trying to change. And yet that's what they're drawing on.

Choral: Mmm (all together; kind of like "Oh, I get it")

(multiple participants)

Paul (F): So doing this doesn't really get to challenge their current teaching.

Amanda: Sure, sure.

Paul (F): Whereas, if you do it afterwards - and you can even maybe I don't know - I don't want to over elaborate but you can even imagine - but you could say "does that fit with how you currently teach?" You see -

Amanda: Well yeah, because we'd have a reference point.

Kara (F): Yeah

Paul (F): Yeah

Amanda: So that, versus it being kind of like "whatever lesson out there that you may or may [not] have taught this is the way I would have done it". And being more specific, that way they have a model that goes with what we're trying to do and accomplish.

In this excerpt, after Kara made the same suggestion that she shared in the previous coach PD session, Amanda responded by not only revoicing her suggestion but also providing a rationale ("that way you have something to refer back to"). Paul then added to Kara's suggestion by suggesting one reason why the current order of activities may not be productive from a teacher's perspective. Specifically, he said that the way they facilitated the Sorting Activity did not provide teachers with an image to use in making sense of the instructional practice statements other than their current practices (which were the very practices the coaches were aiming to

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support teachers in problematizing). Amanda again responded by restating the suggestion and rationale in her own words, which indicates that she understood and agreed with the facilitators' recommendation.

Amanda's contributions indicate that she and the facilitators had established a shared understanding of the source of the difficulty around the facilitation of the Sorting Activity. Namely she and the facilitators now pointed to structural issues in the order of the activities. Since they were on the same page in terms of the source of the difficulty, Amanda could understand the facilitators' suggestion to change the order and was in a better position to take up this recommendation.

One reason for this shift in the way Amanda conceptualized the difficulties in the Sorting Activity might have been that she began to question an underlying assumption of the activity. Specifically, she began to doubt that the teachers and the coaches had a shared understanding of the logic of CMP2 lessons and shared images of the instructional practices described in the statements. In fact, before the above exchange (immediately after showing the clip of the Sorting Activity), Amanda was asked to share her thoughts about the clip. She replied, "I just thought everybody was going to be on the same page as I was so we were all going to get the right answers". In other words she assumed that the teachers would interpret the statements using the same images of practice that she used. Thus, she did not anticipate this type of difficulty when she had designed and facilitated the Sorting Activity.

As I mentioned before, adding an explicit goal about developing *shared understandings* of the sources of difficulties could improve the design of this type of work with coaches in the future. Specifically, by providing opportunities for the coaches to discuss and question the assumptions underlying the activities they planned for teacher PD, we could better support them

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in raising, for example, the issue of how teachers might understand the lesson phases and the instructional practices described in the Sorting Activity.

Summary

During this session:

- There was no evidence that the coaches perceived our collaborative work as a context to work on planning and leading teacher PD more generally, and the coaches did not contribute to the development of a planning routine.

- The coaches continued to make contributions that demonstrated that they viewed difficulties as opportunities to improve the design of the teacher PD session. In particular, Amanda began pointing to structural issues in the order of the activities and took up suggestions that would substantially impact the design of the PD.

Cycle Three: Coaches' PD Facilitation Practices in Pilot Teacher PD Session III

Twenty-five days after the third coach PD session, the coaches co-led a pilot teacher PD session that was video-recorded. This teacher PD was designed to support the 6th grade teachers in planning and teaching a unit on adding and subtracting decimals. In the following section, I describe the coaches' facilitation practices in this teacher PD session, and consider the extent to which the coaches made progress towards the immediate goal for coach PD session three as well as the three long-term goals. I also attend to the extent to which the coaches developed unproductive or unintended practices as a consequence of the coach PD session.

Evidence of Progress towards the Goal for the Third Coach PD Session

      Goal: viewing the coach PD session as a context in which to work on planning and facilitating teacher PD more generally. Recall that the session goal for the third coach PD session was that the coaches would view our collaborative work during these sessions as a context in which they could develop their PD design and enactment practices. As was mentioned earlier, there was no evidence that the coaches viewed the coach PD session as a place to work on their practices as PD leaders more generally, and the coaches did not adopt a routine for planning teacher PD. However, the coaches appeared to adjust their routine for *enacting* teacher PD. Specifically, because they were again working with the 6th grade teachers they did not facilitate the anticipation guide or the Sorting Activity (they had already elicited these teachers' perspectives of the phases of CMP2 lessons). They did however prompt the teachers to examine all of the lessons within the focal unit and then led a discussion of the goals for the unit in relation to the goals for each lesson. They also modeled one of the lessons as they had done in the two previous teacher PDs. In addition, they again ended with a reflective discussion except this time the focus of the discussion was on the problems that are likely to arise when teachers omit the first few lessons and go straight to the last lesson.

    During the reflective discussion, the following exchange took place:

Malcolm: Why did the author choose to place the lessons in the order that they're in? What was significance in the way they designed the lesson - 1.1, followed by 1.2, followed by 1.3?

FT7:   Well that's what I was thinking about... if you get [students] to estimate before they actually work on the answer they kind of could check to see - are they - do they match. Kind of thing.

FT6:   They learn that reasonableness. You know.

Malcolm: Yeah it definiately develops -

| FT6:	Does that make sense? Is that reasonable?
Malcolm:	Yes, it definitely develops that reasonableness understanding. So what would the students miss if we just jumped to 1.4 and taught the algorithm from the beginning? What - what would they miss? Instead of progressing through all of the lessons.
FT8:	They might understand how to phisically put things on paper, but they don't understand the why and the how come and the deeper relationship to the math - underlying math concepts.
Malcolm:	Yes, yes, that deeper relationship - it adds rigor to what we're doing. And it gives them that understanding behind what we're doing and why we do it that way.

In this excerpt, Malcolm asked key questions that focused on the common and problematic teacher practice of skipping to the last lesson and beginning the unit by teaching the algorithm. Specifically, he prompted the teachers to think about the purpose behind the structure of the unit and asked about potential student learning opportunities that would be omitted when teachers move immediately to the final lesson in the unit. It is important to note that Malcolm did not press on teacher contributions during the reflective discussion. This was likely because at this point in the session they were running short on time (in fact, teachers had begun packing up and commented on the time during the transition immediately before Malcolm began this reflective discussion).

Although there was room for improvement in the design and enactment of these activities, the fact that the coaches continued to facilitate some of the same activities (e.g. examining lessons and discussing the goals, modeling a lesson, and having reflective discussions about common instructional issues and how they relate to student learning opportunities) for all three pilot teacher PD sessions demonstrated that they viewed these as productive activities in which to engage teachers.

Evidence of Progress towards Long-term Goals for Our Work with the Coaches

   Overall goal one: developing views of instructional improvement as a developmental trajectory rather than as rectifying deficits. Our first overall goal for the work with the coaches was to support them in coming to view their role in PD leadership as supporting teachers' development of improved instructional practices, rather than as simply identifying and attempting to "fix" deficits in their current practices. In reviewing their third pilot teacher PD session, there was an indication that the coaches began to conceptualize these teacher PD sessions as a sequence of linked activities. The coaches named and introduced this pilot teacher PD session "Phases of the Lesson Part 2: Making Connections" (see Figure 7). By designating this PD session as "part 2", they not only demonstrated that they viewed this PD with the 6th grade teachers as connected to the prior PD session with 6th grade teachers, but also viewed this as the second in a series of PD sessions. This reflects a view of professional development as a developmental trajectory.
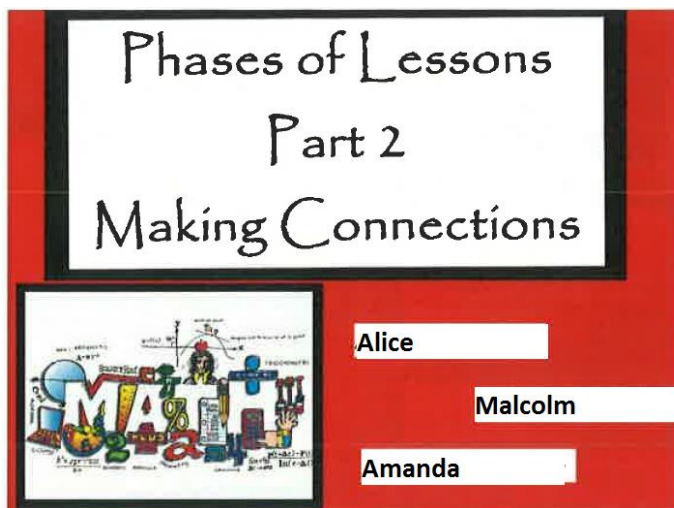
Page 1

Figure 7: First page of the PowerPoint presentation that the coaches created and used for teacher pilot PD session III

However, there was also an indication that at least Alice may, on some occasions, have still viewed the purpose of PD as finding and correcting deficits in teachers' current practices. Specifically, right before Malcolm facilitated the reflective discussion (but after the model lesson and the discussion of the goals for each of the lessons), Alice facilitated a discussion in which the teachers compared the goals they had generated throughout the session to the objectives written in the teacher's edition of the CMP2 curriculum. During this comparison discussion, the following exchange took place:

Alice: Alright so we are going to review the goals that we already wrote for 1.1, 1.2, 1.3, 1.4 and compare them to what the authors had in the book to see what they intended for the goals to be. And then we're going to come up with our overall theme of what is really happening in Investigation 1. So we had previously written (reading off the chart paper where Malcolm had previously recorded the teachers' goal statements) "estimate decimals with sums and differences, over estimate and under estimate, estimating decimals to a whole, round using benchmarks, and dealing with money to determine if you have enough". So in the teacher's edition, they say the goals were (reading off the PowerPoint Slide where the objectives from the textbook are displayed) "to use benchmarks and decimal-fractional relationships to develop estimation strategies for finding decimal sums". And also (continues reading) "to consider the relative size of a decimal prior to developing approaches to finding exact decimals or differences". So how do we compare with what we came up with?

MT7: The first one is good. The second one I don't know if we necessarily address the the relative size of the decimal. Maybe we did, but not in those terms.

FT3: We did. We did when we estimated -

Alice: Yeah, we've got that - rounding with benchmarks, that's estimating (looks at MT7 and nods with exaggeration). Okay. Let's look at 1.2.

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(Alice again reads the teacher generated goals off of the chart paper and has MT7 read the textbook objectives off the PowerPoint slide)

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Alice: Ok and how do ours compare?

MT7: Exact.

FT6: Aligned.

Alice: We're on the money?

FT6: We're on the money.

Alice: Alright moving on to 1.3. This is the one that Malcolm modeled for you.

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(Alice again reads the teacher generated goals off of the chart paper and has MT4 read the textbook objectives off of the PowerPoint slide)

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Alice: So we pretty much nailed that one didn't we.

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(Alice moves on and reads the teacher generated goals off of the chart paper then reads the textbook objectives off of the PowerPoint)

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Alice: So (looking at FT1) we did pretty good?

FT1: Mmm hmm.

In this excerpt, Alice facilitated the comparing of the goals as if the objectives in the teacher's edition were the "correct answers" and they had to check whether their answers were correct. Many of her responses explicitly conveyed to the teachers that they were correct (e.g. "right on the money" and "nailed it"). In other words, the way Alice facilitated this activity communicated to the teachers that their ideas about the goals for student learning were either correct or incorrect. By facilitating this activity in this way, Alice deferred to the authority of the textbook (Luke, DeCastell, Luke, 1983; Remillard, 2005). Deferring to the textbook can be problematic as it fosters a focus on "content coverage" without considering the rationale for the sequencing of the activities. Thus, deferring in this way can place the emphasis on *what* students are to learn without considering *how* or *why* students are to learn it.

Overall goal two: designing supports for teachers' learning informed by ongoing assessments of teachers' current practices. The second overall goal for our work with the coaches focused on supporting them to design and enact PD based on teachers' current practices. In this third pilot teacher PD, the coaches incorporated a discussion about a common and problematic practice that they had noticed when observing teachers teaching the focal unit. Specifically, during the reflective discussion at the end of the PD session, Malcolm facilitated a brief discussion about teachers omitting the first few lessons in the unit and directly teaching algorithms. I think it is important to note that the coaches did not frame the discussion about teachers' current practices as "you all as teachers often skip to lesson 1.4". Instead, they framed the discussion in terms of "what students miss when teachers skip". Arguably, this is a more productive way to frame such a discussion with teachers because it focuses on potential opportunities for student learning and does not reflect the assumption that the purpose of PD is to find and correct deficits in teachers' current practices.

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Overall goal three: facilitating teacher PD by pressing on teachers' ideas

differentially. The third overall goal for our work with the coaches was to support them in

facilitating teacher PD by building on teacher contributions. I found that the quality of the

coaches' press again varied across activities. For instance, during the discussions of the goals for

the individual lessons, the coaches responded to teachers' ideas differentially. For example, the

following exchange took place while Alice led a discussion of the goals for lesson 1.1.

Alice:	FT3, what did you and your partner write down for the goals for 1.1?
FT3:	We said estimating decimals using sums and differences with decimals.
Alice:	And Malcolm is going to chart for us. FT3, good job.
FT3:	Thank you.
Alice:	MT2, did you and your partner have anything different?
MT2:	No, we had the same thing.
Alice:	Same exact words and everything?
MT2:	(Looking down at his paper) It says estimating decimals. Yeah.
Alice:	Wow! Awesome. Let's see. FT4, did you and your partner have anything different?

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(FT4, FT2, and MT4 share similar goal statements)

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FT5:   We included money.

Alice: Tell me more about the money.

FT5:   We want more.

Choral: (laughs)

(Ts all at once)

FT5:   No. We said estimating money to determine if you have enough to buy stuff.

Alice: You rock the math world.

Choral: (laughs)

(Ts all at once)

In this excerpt, Alice pressed only when further explanation was needed. For example, Alice did not press on FT3's contribution (that a goal of 1.1 is for students to "estimate with decimals using sums and differences") as it was already a relatively complete and thorough statement of a goal for student learning. Moreover, FT3 articulated a pertinent and very central mathematical goal for student learning. However, Alice did press on FT5's statement ("we included money") as it was neither complete nor obviously relevant. FT5 expounded upon her original response and explained that she and her partner saw estimating whether a given amount of money would be sufficient to purchase specific items as a goal for student learning. After this explanation, the mathematical and pedagogical significance of FT5's original "money" contribution became clear. But this explanation was only offered *after* Alice pressed FT5. Thus, during the discussion of the goals of the lessons, Alice only pushed teachers to say more when their contributions were either incomplete or when the mathematical or pedagogical significance of their contributions were not apparent to other teachers. In other words, Alice's requests for clarification were often essential in order for the listening teachers to fully understand what the participating teachers were sharing.

In addition to Alice's differential press during the discussion of the goals, Malcolm pressed differentially on teacher ideas when he led the model lesson. However, the coaches did not press the teachers during other activities. For example, as described above, Malcolm did not press on teacher contributions during the reflective discussion at the end of the session. Again, Malcolm's lack of press in this reflective discussion is likely because they were running short on time. Across the three teacher PD sessions, I have highlighted evidence that demonstrates the coaches' progress towards this goal. Specifically, Alice's differential press during the discussion of goals in this session, Amanda's press during the Sorting Activity in the second teacher PD, and Malcolm's press during the reflective discussions for both the first and second teacher PD demonstrates an improvement in the coaches ability to facilitate teacher PD by pressing on teachers' ideas differentially.

Summary

During this pilot teacher PD:

- The coaches appeared to continue to develop a routine for *enacting* teacher PD.

- The coaches demonstrated that they were beginning to conceptualize the teacher PD sessions they led as a sequence of linked activities. However, they also continued to design and enact activities that conveyed to the teachers that their ideas were correct or incorrect.

- The coaches designed supports for teachers' learning that were informed by ongoing assessments of teachers' current practices (e.g. they incorporated a discussion about a current teacher practice that is common and problematic).

- The extent to which the coaches pressed on teachers contributions differentially continued to vary across activities.

Summary of Findings and Recommendations across the Three Cycles of Support for the

Coaches

Consistent with the intent of design research, there are essentially two levels of findings. The first level is the pragmatic level and includes specific findings about what these coaches learned, what the process of their learning was, and the extent to which our design supported them in their learning. In the following section I discuss these findings by summarizing the coaches' progress on each of our overall goals, suggest modifications based on these findings, and share additional insights I gained from this analysis. The second level is the more theoretical level and includes findings about how the "pragmatic findings" constitute a rationale for proposing revisions to the design of supports for PD facilitators more generally. I discuss these findings in greater detail later in the discussion chapter.

What the Coaches Learned and the Extent to Which Our Design Supported Their Learning

Overall goal one: developing views of instructional improvement as a developmental trajectory rather than as rectifying deficits. At the start of our work with the coaches, they designed and enacted activities that reflected mixed views of instructional improvement and the purpose of PD. Specifically, they planned and led activities such as the anticipation guide and the Sorting Activity in ways that reflected an assumption that the purpose of PD is to find and correct deficits in teachers' current practices. However, during the same teacher PD session, they also enacted activities such as the model lesson and reflective discussion following the model lesson in ways that indicated a view that the purpose of PD is to provide opportunities for rich discussions about practice.

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By the end of our work, the coaches demonstrated that they were beginning to conceptualize the teacher PD sessions they led as a sequence of linked activities. For example, they said that they were first working to support teachers in developing an appreciation of the student learning opportunities that could arise in the Summary phase, and would then in the next semester work to support teachers in planning and preparing for high-quality discussions. They also demonstrated that they viewed teacher PD sessions as being connected by explicitly naming their last teacher PD session as the second in a series of PD sessions with the 6th grade teachers.

Our design supported them in making progress toward this goal by providing opportunities to discuss current teacher practices and using these discussions as a basis for clarifying and developing a shared understanding of the goals for teacher learning. This shared understanding of teacher learning goals served as a precursor to supporting the coaches in coming to take a developmental stance on teacher learning. We also supported them in designing teacher PD based on this stance by emphasizing the goals for teacher learning while reviewing and reflecting on prior teacher PD sessions, and drawing on these reflections when preparing for upcoming teacher PD sessions. In this regard, one of the coaches (Alice) mentioned in an interview conducted by Paul and a research assistant after the third cycle that she valued viewing video clips of pilot teacher PD sessions. In response to the question "what did you find useful, if anything, in those sessions?", Alice said:

> Alice: …looking at the video clips…because if for example something came up during the (teacher) professional developments that we struggled with or we weren't sure how to handle, we can pull up that clip and then discuss, okay this is what occurred (and this is what we could do) for next time.

We can improve our design for future work with coaches by attending more closely to the extent to which the coaches and researchers developed a shared understanding and/or shared image of what the work of supporting teachers in making progress toward these goals might look like. In other words, though the coaches and researchers were on the same page in terms of the goals for the teacher PD sessions, we also needed to be on the same page in terms of *how* to support teachers in making progress towards these goals.

Overall goal two: designing supports for teachers' learning informed by ongoing assessments of teachers' current practices. At the beginning of our work with the coaches, they planned activities designed to elicit current conceptions of the phases of CMP2 lessons but, in enacting these activities they framed instructional practices too abstractly to influence the enactment of other activities and the design of future teacher PD sessions. They also elicited teacher responses without adequately attending to the reasoning behind the responses, thus limiting the extent to which they could build on and influence teachers' current understandings and practices. By the end of our work, the coaches demonstrated that they could design and enact activities that were informed by ongoing assessments of teachers' current practices. For example, they incorporated an opportunity to discuss the common and problematic practice of skipping lessons and starting a unit by teaching algorithms as part of their last teacher PD session.

Our PD design supported the coaches in making progress towards this goal by selecting specific lessons that district leaders identified as difficult for teachers to enact, and by providing opportunities to plan teacher PD around these lessons. We also provided opportunities to discuss how teachers typically enact the focal lesson and why these practices may be problematic as a means of supporting the coaches' progress towards this goal. These discussions served as a first step in designing supports for teachers based on ongoing assessments of their practices and

provided opportunities for the coaches to name the practices on which the teacher PD would focus. Also, selecting a focal lesson in which to ground our discussions of teachers' practices supported the coaches in designing PD that focused on specific instructional practices. In other words, by selecting a specific lesson and providing opportunities for the coaches to plan teacher PD that was designed around this focal lesson, we supported them in designing PD that focused on specific instructional practices as they addressed instructional challenges that were likely to occur in an upcoming lesson that teachers were actually expected to teach.

Since talk about teacher practices tended to remain abstract during the teacher PD sessions, we could improve our design to better support the coaches' progress towards this goal in future work by emphasizing the importance of providing representations of instructional practice *before* enacting activities in which teachers talked about their practice. Across the teacher PD sessions, there were richer discussions of teaching practices after the teachers had experienced a model lesson. This was because the model lesson provided an opportunity for the teachers to develop shared images of the practices, thereby enabling the teachers to ground their contributions in specific experiences and observations from the model lesson. One of the coaches, Amanda, appeared to develop an understanding of the role of representations of instructional practice during coach PD session three, but I conjecture that if all three coaches developed this understanding sooner it would have improved the design of their teacher PD. Thus we could improve our supports for the coaches by being more deliberate in helping them understand why representations of practice are essential in supporting improvements in practice and making it a session goal.

Overall goal three: facilitating teacher PD by pressing on teachers' ideas differentially. At the beginning of our work with the coaches, the quality of their press on

teacher ideas varied across activities, and the extent to which the coaches pressed differentially on teachers' contributions continued to vary across activities at the end of our work with them. However, I have highlighted evidence that the coaches made progress towards this goal. For example, Alice's differential press during the discussion of goals in teacher PD session three, Amanda's press during the Sorting Activity in teacher PD session two, and Malcolm's press during the reflective discussions in teacher PD sessions one and two.

Our PD design supported the coaches in making progress towards this goal by helping them in designing teacher PD sessions that aimed to support teachers' development of particular instructional practices. Designing the teacher PD around specific teaching practices served as a precursor to pressing on teachers' ideas differentially because it supported the coaches in identifying which teacher ideas on which it would be beneficial to press. The facilitators also supported the coaches in making progress towards this goal by explicitly suggesting to the coaches that they identify two or three ideas on which to press teachers as part of the sequence of issues that should be addressed when planning PD.

In the interviews with Paul after the third cycle, two of the coaches (Amanda and Alice) mentioned that they valued viewing video clips of pilot teacher PD sessions because it supported them in becoming more aware of the extent to which they were pressing. During Amanda's interview, the following exchange took place:

Paul: Now as part of (our work together) we looked at some video clips, right, from some of those (teacher PD) sessions?

Amanda: Mmm hmm.

Paul: Has that been helpful?

Amanda: Mmm hmm.

Paul: In what way?

Amanda: Well especially for me.

Paul: Yeah.

Amanda: The last one was just an eye opener and so the whole time I did this last one I was like, "I need to make sure I expand"… I didn't, and I stayed quiet on one of the responses a teacher said and I was like, "man, I did it again". So I think I'm just more aware of it instead of just saying, 'good job' I should have pushed back some more and I think I'm just more - if I hadn't seen that clip I would have never known.

For her part, Alice responded to an interview question about how watching video clips influenced what she has done in subsequent teacher PD as follows:

Alice: I think what it's helped us do is fine tune things and help us know where we need to push back further - if a teacher presents something… when to push them further in their thinking.

Given that the extent to which the coaches pressed on teachers' ideas continued to vary across activities, we could improve our design for future work with coaches by more explicitly focusing on press or lack thereof while reviewing and reflecting on their facilitation practice in previous teacher PD sessions. Specifically, we could call the coaches' attention particularly to their responses to teacher ideas and ask them questions about if and how they would alter their responses and improve press following specific teacher ideas. We could also improve our design by providing opportunities during the coach PD sessions for the coaches to rehearse pressing on teacher ideas in the context of teacher PD. There was evidence that the coaches were capable of consistently pressing on student ideas in the context of a mathematics classroom. Thus, there are likely improvisational aspects of the "in the moment" act of pressing on teacher ideas that it would have been useful for the coaches to practice during the coach PD sessions where there were lower-stakes. Finally, as I mentioned before, one aspect of the planning routine we intended to co-develop with the coaches was selecting two or three ideas to consistently press on

throughout the teacher PD session. Therefore another way we could improve our design to better support the coaches' progress toward this goal is by explicitly outlining and naming aspects of the planning routine and by supporting the coaches in appropriating the routine.

Additional Insights

The enactment of the design. While facilitating the coach PD sessions, the two facilitators consistently enacted specific facilitator practices that supported the coaches in improving their PD design and facilitation practices. One such practice was attributing authority to the coaches. They attributed authority primarily by pushing questions the coaches asked back to the coaches and by providing opportunities for the coaches to think further about their own suggestions and questions (e.g. "it's up to you" or "let me bounce that back to you"). Another facilitator practice that supported the coaches was consistently refocusing and pressing with an emphasis on the goals for teachers' learning (e.g. "What are your goals for this session?" and "What would be your long-term goals for working with [the teachers]?").

In future iterations, we could improve the enactment of the design by consistently pressing the coaches to articulate what their proposed work of supporting teachers might look like. This might entail either asking coaches for further details about how they planned to support teachers and why they thought that their proposed activities would be productive or providing opportunities for coaches to rehearse some of the more performative aspects of their plans. In fact, in the interview with Paul after the third cycle, one of the coaches (Malcolm) indicated that he thought this modification to the design would have been helpful. In response to a question about how useful our work together was, Malcolm said the following:

Malcolm: Working through the math and defining the mathematical goals was great. When we got to trying to design the PD, it was more of we were talking about it, but we

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didn't - we didn't get anything written down. Yeah, I felt as though "okay, we did all this discussing" and I'm thinking "okay, now what did we say and how are we gonna put this together? What is it gonna look like".

I conjecture, more consistent press on these issues would have better supported the coaches in viewing activities such as the anticipation guide as problematic. For similar reasons, we could improve the enactment of the design by consistently pressing the coaches to share their understandings of the sources of difficulty they encountered while facilitating teacher PD. I conjecture that consistent press on this issue would have better supported the coaches in thinking through how to improve the design and enactment of their pilot teacher PD.

Modifications to the goals for coaches' learning. Reflecting on my analysis, I think the three overall goals that we identified for our work with the coaches were necessary and sound. However, I conjecture that in future work with the coaches, adding an explicit session goal about developing shared understandings of the sources of the difficulties that the coaches encountered while facilitating teacher PD could improve our work. After this analysis, it is clear that not only do the coaches need to view difficulties as opportunities to improve PD, but they also need to be supported in identifying the sources of these difficulties.

Additional modifications to the supports provided for the coaches. One of the session goals for coach PD session one was that the researchers and the coaches develop a shared understanding of the nature of our collaborative work. However, there were no explicit prompts for the coaches to share their thoughts about the nature of our collaborative work during the session. Thus in order for the research team to better assess the extent to which they and the coaches are on the same page, we would need to modify the design of the first coach PD session and include explicit opportunities for the coaches to share their thoughts about the nature of our collaborative work.

Another modification to the supports we provided the coaches involves the facilitators explicitly outlining and naming aspects of the routines that were being developed. Supporting the coaches in co-developing a routine for designing teacher PD was related to session goals for each of the three coach PD sessions. However the facilitators did not initiate any discussion of the process of planning teacher PD. As a consequence, it is not clear that the coaches perceived what we were doing as a routine. Thus, we should modify the design and enactment of the coach PD sessions by including questions and activities that support the coaches in stepping back and reflecting on the planning process and supporting them in outlining this process. By including such questions and activities, we would better support them in perceiving what we were doing as a routine, in contributing to the ongoing development of the PD planning routine, and in appropriating such a routine.

Finally, as I have already mentioned, adding an explicit goal about developing shared understandings of the sources of difficulties could improve the design of this type of work with coaches in the future. This would have implications for our design. Specifically, we would need to provide opportunities for the coaches to discuss and question the assumptions underlying the activities they planned for teacher PD. We would also need to ask questions and design activities that could support them in raising issues around how teachers might be supported in developing specific understandings**.**

CHAPTER V

DISCUSSION

Recall that I set out to answer the question of what PD facilitators need to know and be able to do in order to design and implement high-quality professional development (HQPD). In other words, one of my questions was what are the goals for PD leaders' learning? I also aimed to contribute to our understanding about how to design PD to support the development of such expertise, particularly PD that is organized around upcoming lessons that teachers find challenging to teach well. In the following section, I discuss the answers to my research questions in light of the findings from this study.

What are Goals for PD Leaders' Learning?

Literature on HQPD suggests that, in order to design and implement PD that is likely to support teachers in significantly reorganizing their current practices, PD facilitators must view and approach supporting professional learning as a progression, rather than as a one-time handover of information and ideas. Given that the main goal for HQPD is the development of ambitious instructional practices, teacher PD should be organized around specific high-leverage instructional practices (Ball et al., 2009) and should provide sufficient opportunities for teachers to investigate and enact (Grossman et al., 2009a) these practices. Thus PD must be viewed as an on-going support for teacher learning, and PD facilitators must come to view supporting instructional improvement as a teacher developmental trajectory.

Current research on teacher learning also indicates that for PD to be effective it should focus on central issues of instruction and be organized around the materials that teachers use in their classrooms. Since HQPD aims to support teachers in fundamentally reorganizing their practice, it must be designed with a focus on what teachers are expected to do in their classrooms and provide opportunities for them to participate in activities that approximate the targeted practices. Thus PD facilitators must be able to design and implement teacher PD activities that are close to practice (Ball & Cohen, 1999) and are informed by assessments of teachers' current practices.

In addition, literature on HQPD suggests that, in order to design and implement PD that would support teachers in significantly reorganizing their current practices, PD must provide them with opportunities to examine their current ideas and instructional practices, and to identify and discuss aspects of these ideas and practices that may be problematic or unproductive. How facilitators lead discussions is key to focusing teacher conversation on important ideas, to helping teachers to articulate and examine their reasoning, and to supporting them in developing knowledge and practices that are integral to ambitious mathematics instruction. Thus, PD facilitators must be able to press on teacher ideas differentially and build on teacher contributions while leading PD.

We framed these three capabilities as overall goals for our work with the coaches. The analysis I have presented indicates that these are indeed appropriate goals for PD facilitators' learning. Specifically, my findings indicate that teacher PD facilitators who come to view instructional improvement as a developmental trajectory rather than as rectifying deficits are better able to provide on-going opportunities for teachers to investigate and enact specific instructional practices. Moreover, they are better able to design and enact PD activities that fit

together coherently and that support teachers in making progress towards clear goals. My findings also indicate that PD facilitators who design supports for teachers' learning that are informed by ongoing assessments of teachers' current practices are better able to design or select PD activities that focus on what teachers are expected to do in their professional work and approximate targeted practices. In addition, my findings suggest that PD facilitators who press on teachers' ideas differentially are better able to focus teacher conversation on important ideas and support teachers in identifying and unpacking problematic practices and ideas. In other words, the case I have reported indicated that making progress on these three outlined goals for coaches' learning is likely to support improvements in the overall quality of the teacher PD that they design and enact.

How Should PD be Designed to Support the Development of Such Expertise?

My findings indicate that the overall design for supporting coaches' learning described in this dissertation constitutes a good starting point for developing expertise in designing and facilitating teacher PD. That is engaging PD facilitators in cycles of pedagogies of investigation and enactment with accomplished others has the potential to support them in making progress towards the identified goals for their learning and in developing more sophisticated PD design and facilitation practices. Specifically, providing opportunities to plan for upcoming teacher PD sessions, to investigate prior teacher PD sessions by analyzing video clips, and then to redesign plans for teacher PD sessions (all with accomplished others) can support PD facilitators in developing more ambitious PD designing practices (such as designing supports informed by teachers' current practices). Providing opportunities to enact planned teacher PD sessions, to reflect on these enactments with accomplished others, and then to reenact PD sessions based on

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these reflections support PD facilitators in developing more ambitious facilitation practices (such as differential press on teacher ideas).

However, my analysis indicates that the design and enactment of these supports for the development of PD facilitator expertise can be improved. I identified three modifications to the design that would improve the supports for PD facilitators. First, my findings indicate that adding the goal of developing a shared understanding of sources of difficulty encountered while facilitating teacher PD would improve the supports provided to PD facilitators. Specifically, adding this goal would better support PD facilitators in redesigning and improving future teacher PD sessions. Second, my findings indicate that providing opportunities for PD facilitators to explicate their proposed work of supporting teachers' learning in greater detail would improve the supports for PD facilitators' learning. More detailed discussions of their plans for teacher PD could support PD facilitators as they design PD sessions by revealing some potentially problematic aspects of their plans. Third, my findings indicate that providing opportunities for PD facilitators to rehearse some of the improvisational aspects of facilitating teacher PD would also be an improvement. These improvements to the design would better support PD facilitators in developing their PD design and enactment practices.

In terms of the enactment of supports for the development of PD facilitator expertise, my findings indicate that being deliberate in explicitly outlining and naming aspects of routines that may be developing would significantly improve supports for PD facilitators. By helping PD facilitators in perceiving the process of planning for teacher PD as a routine while also co-developing the routine, this modification may better support PD facilitators' development of PD designing practices. My findings also indicate that explicitly focusing on facilitator press (or lack thereof) while analyzing video clips of prior teacher PD sessions would improve the supports

provided for PD facilitators. By calling facilitators' attention to their responses to teacher ideas and prompting them to think of alternative responses that may improve opportunities for teachers' learning, this modification may better support PD facilitators' development of PD enactment practices.

Implications for the Development of District and School Capacity to Provide High Quality Professional Development

Recall the motivation for this dissertation was to contribute to the challenge of supporting large U.S. urban districts in building the capacity for instructional improvement in mathematics. In the above section, I shared implications from this professional development design study, thereby contributing to the development of a practice-specific professional development theory that specifies 1) a learning process for facilitators' development of more sophisticated PD planning and implementation practices, and 2) the means of supporting this learning process. I now step back from the details of the analysis to locate this dissertation in the broader context of efforts to improve the quality of mathematics teaching on a large scale.

The design study I have reported was premised on the assumption that the partner district's capacity for instructional improvement would be enhanced if the coaches became more skillful in designing and leading HQPD for teachers. However, we were also aware that our work with the coaches would not be sufficient by itself to support instructional improvement because HQPD often yields "disappointing results" (Hill, Beisiegel, & Jacob, 2013). This is because the impact of high-quality professional development on teachers' classroom instruction is mediated by the school and district contexts in which they work (Cobb, McClain, Lamberg, & Dean, 2003; Coburn, 2003). For example, school leaders (e.g. principals) are increasingly expected to act as

instructional leaders by sustaining an instructional vision, brokering teacher learning opportunities, monitoring the quality of instruction and student learning, and fostering teacher collaboration (Larbi-Cherif, 2015). In doing so, school leaders communicate instructional expectations to teachers and hold them accountable for meeting these expectations (Katterfeld, 2011). However, these expectations are often at odds with the goals of HQPD (Jackson et al., 2015).

Other important aspects of school and district contexts that influence teachers' instructional practices include the instructional materials and resources that teachers use (Stein & Kaufman, 2010; Stein, Remillard, & Smith, 2007) and other sources of support on which teachers can draw (e.g. teacher collaborative time scheduled during the school day, teachers' advise networks) (Jackson & Cobb, 2012; McLaughlin & Mitra, 2001). Thus supporting instructional improvement at scale requires direct supports for teacher learning *as well as* the reorganization of the school settings in which teachers work (Bryk, Sebring, Allensworth, Luppesco, & Easton, 2010; Cobb et al., 2003; Cobrun, 2003; Jackson & Cobb, 2012). It is in this sense that our work of supporting district PD facilitators' design and enactment of HQPD is necessary but not sufficient to support district capacity for instructional improvement at scale.

Despite this limitation in the potential impact, this design study is a contribution to research literature on supporting instructional improvement because it clarifies the knowledge and skills that PD facilitators need in order to design and lead HQPD, and describes an empirically grounded design for supporting PD facilitators' development of such expertise. Specifically, this analysis specifies supports for PD facilitators' learning and indicates why these supports are necessary and why they have the potential to be effective.

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