CHANGING TEACHING PRACTICE: EXAMINING PROFESSIONAL DEVELOPMENT IMPACT ON MATHEMATICS DISCUSSION LEADING PRACTICE

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Decades of research has shown that most professional development fails to result in changes to teachers' classroom practice. This project explores an innovative professional development focused squarely on mathematics teaching practice and seeks to understand the features of the professional development that effect classroom level change.

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Problem Statement

Supporting teachers to improve their practice is a fundamental challenge for professional development. Decades of research have demonstrated that many common approaches to professional development do not adequately support improvements in teachers' capabilities (e.g., Cohen & Hill, 2001). In response, there has been increased work to develop new forms of professional development. Careful studies are needed to understand features of professional development design that support the learning of practice and how key variations in the design impact teacher learning. Further, many studies of professional development do not examine changes in teaching practice and such studies are needed.

This study is grounded in our project's work over the last decade to address the challenge of supporting the learning of practice using an approach to professional development situated in a common "live" case of elementary mathematics instruction occurring as part of a summer program for fifth grade students. The class comprises primarily Black youth, along with a small number of Latinx and white children, mostly from low-income families. The teacher is experienced and comfortable with making her practice visible and open to others. The approach uses this classroom as a "common text" for working on practice, where participants are not only watching and discussing, but are engaged in developing and refining teaching practice. Participants' engagement approximates a form of "legitimate peripheral participation," (Lave & Wenger, 1991) through structured conversations about the lesson plans, close observation, analysis of student tasks, and examination of records of teaching and learning. In addition, participants receive professional development focused on leading mathematics discussions.

The research explores the impact of participation in these structured ways on teachers' practice, as well as on their knowledge and dispositions. Our contribution is to rigorously study the impact of our professional model in situ to determine whether and how the work transfers into classrooms. Specifically, our initial study seeks to answer the following questions: What do

teachers learn from structured participation in the class? Does their participation impact their own teaching practice, and if so, in what ways? Does the addition of professional development focused on a particular teaching practice impact teachers' own practice, and if so, in what ways?

Theoretical Framework

Mathematics teaching is something that people do; it is not merely something to know. Teachers must use knowledge flexibly and fluently as they interact in specific contexts with students, with the aim of helping those students become proficient with mathematics. This interactive and dynamic view of instruction can be represented by the "instructional triangle" (Cohen, Raudenbush, & Ball, 2003), a conceptualization of teaching as interactions among teachers, students, and content, in an environment. This conceptualization has important implications for the design of professional development. It means that professional development must attend to the specialized ways that teachers must understand mathematics, how that knowledge of mathematics interacts with teaching practices that support the learning of their students, and how the context of teaching interacts with all of these factors.

Our professional development is designed to support this type of professional learning and draws on recent work supporting teachers' learning of mathematics content and teaching practices. The work of "video clubs" as a means to increase capabilities at noticing student thinking (van Es & Sherin, 2008) in conjunction with research on lesson study as a means for teachers to learn from teaching and to develop and share practitioner knowledge (Perry & Lewis, 2009) informed the design of our peripheral participation model. Our project builds on these efforts and seeks to learn about impact on teacher practice.

We grounded our professional development in a particular decomposition (Grossman et al., 2009) of the teaching practice of leading a mathematics discussion. We define discussion as "a period of relatively sustained dialogue among the teacher and multiple members of the class" in which students respond to and use one another's ideas to develop collective understanding (TeachingWorks, 2015). Our decomposition is informed by research on orchestrating productive discussions (Smith & Stein, 2011), the concept of talk moves (Chapin, O'Connor, & Anderson, 2013), and research on decomposing practices to support learning (Boerst, Sleep, Ball, and Bass, 2011). The table below shows our decomposition of leading discussions with practices organized into three areas of work: (1) framing, (2) orchestrating, and (3) recording/representing content.

Table 1: Areas of Work and Practices for Leading Mathematics Discussions

Areas of Work		
Framing	*Orchestrating*	*Recording/representing content*
Launching Concluding	Eliciting student thinking Probing student thinking Orienting students towards the thinking of others Making contributions	Keeping accurate public records Using representations to convey key ideas

Methods

The study seeks to determine the extent to which peripheral participation in elementary mathematics teaching and focused professional development impact teachers' actual practice and factors that support their enactment of practice, including their ability to notice the specific work of teaching, and children's mathematical strengths. The broader study focuses on elementary teachers (n = 24), all of whom engaged in peripheral participation in elementary mathematics

teaching for five consecutive days (~25 hours) and half of whom (n = 12) participated in additional professional development across the five days (10 hours) focused on leading a mathematics discussion. We collected and are analyzing a set of pre- and post-measures including measures of teachers' language in talking about students and teaching, and videos of classroom mathematics discussions which are being analyzed using a tool focused on the work teachers do when leading mathematics discussions (Selling, Shaughnessy, Willis, Garcia, O'Neill, & Ball, 2015).

In order to increase the comparability of teachers' skill with discussion leading practice, our team designed a "common" discussion plan based on work developed in a prior study (Garcia, Selling, & Wilkes, 2015; Selling, Shaughnessy, Willis, Garcia, O'Neill, & Ball, 2015). This enabled us to control for task selection and discussion structure. The accompanying technique checklist tool, which captured techniques related to practices named in our decomposition, was expanded to include advanced techniques that could be expected from experienced teachers.

For this initial study, we focus in particular on the impact of the full professional learning experience (~35 hours) on teachers' skill with leading mathematics discussions. To focus in on this impact, we selected four case study teachers who represented a range of skill with leading mathematics discussions in the pre-intervention data set. We then examined pre- and post-intervention video of their common discussion lessons. Videos were double coded by members of the research team using the technique checklist tool. Discrepancies in coding were resolved by a consensus discussion and reference to code books developed by the research team.

Analysis

Analysis of pre- and post- common discussion lesson videos utilized the technique checklist tool to examine particular techniques used before and after the intervention. Techniques were coded as present, not present, and not applicable. In some cases where we would expect to see a technique used frequently, for example "asks questions that deepen student reasoning," additional codes of once, more than once, and frequently replaced the code of present. We then compared participants at the technique level to determine whether their use of the technique increased, stayed consistent, or decreased from pre- to post-intervention. Table 1 below shows the positive areas of change for each of our case study teachers in each area of work of leading a mathematics discussion. For example, T12 improved in all 3 techniques from pre-post in the area of launching a discussion.

Table 2: Number of Techniques in Each Area of Work Showing Positive Change

	Launching (3)	Concluding (3)	Eliciting (3)	Probing (5)	Orienting (4)	Making Connections (3)	Making Contributions (5)	Recording/ Representing Content (4)
T12	3	0	1	3	3	2	1	2
T14	0	2	0	1	0	2	1	0
T18	0	2	0	0	1	0	0	0
T22	1	0	2	1	1	3	2	1

The initial analysis shows that the three out of four teachers increased their use of techniques in four areas of work: probing, orienting, making connections, and making contributions. Additionally, half of the case study teachers increased their use of techniques in the remaining

four areas of work.

In addition to the presence of techniques, the team also coded for problematic areas, including unequally distributed participation, ineffective probes, and incorrect/inaccurate mathematical contributions. All case study teachers had fewer issues in their post-intervention discussion than their pre-intervention discussion. Notably, T12 improved in 7 of 8 issue areas.

Discussion

Initial results of the study show promise for the potential of the current professional development design to impact teaching practice. Peripheral participation paired with a focused discussion leading professional development increased teachers' use of techniques core to the work of leading productive mathematics discussions. Next steps for this work are twofold. First, we will examine impacts of the professional development on other indicators including teachers' mathematical knowledge for teaching and their skill with noticing and naming student strengths. Second, we will examine and compare the impact of peripheral participation with full participation on teachers' discussion leading practice and associated factors.

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