UNIVERSITY OF CALIFORNIA, SAN DIEGO

Deliberating Instructional Reform: How Teachers Collectively Negotiate Changing Beliefs and Practices

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Education

in

Teaching and Learning

by

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2017

The Dissertation of Marie Lockton is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

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Chair

University of California, San Diego

2017

Dedication

for Edward, William, and Owen

for their generation

and for the next

Table of Contents

List of Figures

List of Tables

Acknowledgements

Thank you to the UCSD community who have guided me this last four years. Amanda Datnow, you have been more than an advisor. Beyond your guidance and feedback on my work, you have helped me envision a way to do the work I truly want to do. Alan Daly, thank you for finding creative paths around what I could only see as roadblocks. Julian Betts, I greatly appreciate your generous time, fresh perspective, and careful consideration of my work. Paula Levin, I owe a great deal to your uncanny ability to spark new ideas when given very little to work with. To my teachers and cohort, thank you for the thoughtful conversations, practical support, friendship, and food.

To my family and friends, thank you for your support and patience. In particular, thank you, Steven Lockton, for helping me translate my vision into more beautiful, useful graphics. I am grateful for your style, skill, and attention to visual details. Edward, William, Owen, and Steven, you pulled together to provide me the time and space to do this work. Carol Mahedy, I am deeply grateful to you for stepping in to ensure that those who I hold most dear were lovingly nurtured in my absence. I absolutely would not have completed this work without your help. You all not only shouldered my load, but carried me, too.

Finally, to the educators who participated in this research, who I had the privilege of teaching with, and who I have encountered inside and outside of classrooms doing everything they can to strengthen and inspire the next generation, I have learned so much from you.

Chapters 1, 2 and 3 are currently being prepared for submission for publication of the material. The dissertation author was the primary investigator and author of this material.

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Abstract of the Dissertation

Deliberating Instructional Reform: How Teachers Collectively Negotiate Changing Beliefs and Practices

by

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Doctor of Education in Teaching and Learning

University of California, San Diego, 2017

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Under pressure to continually improve student outcomes, teachers are often asked by their schools, districts, and states to implement reforms aimed at changing their instructional practices. Even when research shows these reforms can benefit students, instructional practices in schools often change very little. The way teachers interpret reforms and decide if they are appropriate and feasible in their context can be influenced by the formal and informal conversations they have with other educators (school administrators, instructional coaches, and other teachers) about the their practice. In these conversations, teachers collectively negotiate beliefs and instructional decisions about their students, their academic subject, and their roles as teachers. The forces at play in these conversations are not completely understood, however.

This comparative case study employs qualitative interview and observation methods combined with social network analysis to examine the content and context of teachers' deliberations and interactions about reforms and instructional practice. This year-long study followed the math departments at two urban middle schools undergoing reforms aimed at improving instruction in math. Results showed that deliberation was a key element in changing teachers' beliefs and practices. Teachers experienced more fruitful deliberation when their collaboration time was structured to encourage discussion about student thinking and instructional practices regarding specific math concepts. Opportunities to engage in these discussions with trusted colleagues as well as with schools' wider math departments were both important for supporting teachers' efforts to explore conflicting beliefs about the reforms. Some individuals displayed a high degree of deliberation expertise, engineering deliberations toward a collective orientation that supported the feasibility of reforms at their schools. These teachers enjoyed denser social networks with stronger ties, and individuals who worked closely with them were observed recounting their successes with and arguing for reform-aligned instructional practices. Future research might explore the contextual factors that develop teachers' deliberation expertise over time and the corresponding changes to their social networks and instructional practices.

Deliberating Instructional Reform: How Teachers Collectively Negotiate Changing Beliefs and Practices

The world has changed dramatically over the last several decades. Not only has the internet reshaped the way we communicate with one another across the boundaries of space and time, but more people have access to ever-increasing bodies of research that were previously in the hands of precious few. These advances have enabled leaps forward in fields such as technology and medicine. In the field of education, too, researchers have joined together from diverse academic disciplines such as economics, neuroscience, and anthropology to understand teaching and learning in greater depth and complexity than ever before. Today's students, too, are experiencing life in a way that was simply not imaginable to previous generations, and will face a job market that we cannot yet begin to understand the shape of.

When I moved back to my childhood neighborhood after more than a decade and a half away, I noticed that families were no longer able to make ends meet using the skills they had relied upon in previous years. Parents lacked the skills to adapt to the changing job market. Yet these same parents and the schools in the neighborhood were still emphasizing the skills and using the teaching methods that they had a generation ago. A jarring juxtaposition of new technology and virtually unchanged methods of instruction made me question how the neighborhood schools were meeting the needs of the community. There are undoubtedly benefits to continuity in many cases. If something works, why not continue to use it? Yet in this neighborhood, and in many like it, it was clear that the education the schools were providing was no longer working. The world had changed, but the schools had not changed with it.

The most frustrating part about watching students graduate unprepared for what they would face next was the fact that considerable research and pioneering efforts in other schools had yielded a great deal of knowledge about students' needs and how to fulfill them. Some of that knowledge had made it into the schools in my neighborhood by way of teacher trainings and district and state reform efforts. It had not, however, made its way into the daily instructional practices at the school in any meaningful way. As I explored this phenomenon, I discovered that it was more widespread than my own neighborhood and was well-documented (Cuban, 2013).

Although educational systems have been the focus of many improvement efforts, it has often been noted that teaching in some schools can be slow to change (Opfer & Pedder, 2011; Spillane, 1999). In countries across the globe, there is ever increasing pressure for schools to continually improve student achievement by improving instruction. Reform efforts have met with success in many schools, while in others, the extent of this success varies from classroom to classroom (Olsen & Kirtman, 2002). Even when reforms are backed by research and success in other schools, they frequently fall short of ushering in substantive instructional change in many cases (Cohen, 1990; Spillane, Reiser, & Reimer, 2002).

I have 30 years of experience in the public schools in the United States as a student, teacher, parent, and researcher. During that time, nation-wide and state-wide reforms have shifted the demands placed on teachers. At the school level, school-wide restructuring, district demands, smaller-scale reforms, changing administration, and teacher turnover have altered the way teachers instruct students in many cases. I have noticed wide variation in the way schools and teachers both initiate their own reforms and

enact reforms imposed upon them, resulting in very different student-teacher interactions. As a middle school teacher and as a graduate student researcher, I have spent a great deal of time listening to teachers talk about their practice, their students, their subjects, and reform efforts. Through these conversations, I have come to understand that the way teachers view their context has a lot to do with the instructional decisions they make.

Teachers are ultimately the ones who provide instruction to students, thus teachers play a key role in enacting reforms. In some cases, teachers may fail to implement a reform or may make changes to it either knowingly or unknowingly (Coburn, 2001; Cohen, 1990; Datnow, Hubbard, & Mehan, 2002). If teachers feel that reforms fail to address their students' needs, they may push back against them (Tyack & Cuban, 1995), which may be in the best interest of their students (Gitlin & Margonis, 1995). For this reason, reform efforts work best when those educators enacting the reform have had an active role in co-constructing the effort (Datnow & Stringfield, 2000). Even in cases where teachers choose to faithfully implement externally-imposed reforms, research has documented the tendency of individuals to notice aspects of reforms that already resemble their current beliefs and practices, resulting in superficial rather than substantive instructional changes (Spillane, 2012). Teachers must reevaluate their beliefs and practices in order to make deeper, more fundamental instructional changes (Wheatley, 2002).

Teachers' decisions about instruction have much to do with their beliefs about teaching, their students, their subject, and themselves. A teacher can only implement what he or she believes to be possible (Fives & Buehl, 2012; Horn, 2007). Beliefs about self-efficacy, student ability and motivation, and the nature of learning a subject can

therefore impact what types of instruction a teacher even considers. Similarly, these beliefs play a role in whether or not a teacher sees a need for change or believes a particular change would be beneficial, often impacting the enactment of reforms (Cole & Weinbaum, 2010; Czerniak & Lumpe, 1996; Horn, 2007). Furthermore, the way a teacher interprets the impact of changes varies depending on the beliefs a teacher holds (Oláh, Lawrence, & Riggan, 2010).

Despite the central role played by teacher beliefs in instructional decision-making, individual beliefs do not simply determine teachers' actions. To begin with, teachers' experiences with instruction can impact their beliefs (Guskey, 2002). Further, teachers sometimes hold conflicting beliefs or act in contrast with their beliefs (Fives & Buehl, 2012). This is not surprising when one considers teachers' beliefs within the wider context of teaching practice. Teachers do not work in isolation, but instead are situated in the wider context of grade levels, departments, schools, districts, and wider communities. Teachers' beliefs and practices are influenced by their schools' structure, norms, culture, resources, and social networks (Daly, Moolenaar, Bolivar, & Burke, 2010; Datnow et al., 2002; Opfer & Pedder, 2011; Spillane et al., 2002). Thus, the role of teachers' beliefs in teaching practice is one that shapes and is shaped by the context of teaching.

The relationship between beliefs and context is central to understanding instructional reform since collaboration is often a key component of reform enactment. Not only do teachers turn to one another informally to help make sense of reforms (Coburn, 2001), but many reforms involve structured time for teachers to work together with the aim of improving instruction through collaboration. Teacher collaboration has been shown to be a useful tool for school improvement (Hargreaves, 1994; Lieberman &

Miller, 2011) and appears to be a key factor in building teacher capacity and enacting and sustaining educational reform (Coburn, Russell, Kaufman, & Stein, 2012; Daly et al., 2010; Horn & Little, 2010; Marsh, Bertrand, & Huguet, 2015). Yet the mere act of collaboration is no guarantee of instructional improvement (Hargreaves, 1994; Kelchtermans, 2006). Collaboration can sometimes reinforce beliefs and practices that do not support improved student learning (Horn & Kane, 2015; Spillane, Kim, & Frank, 2012). The power of collaboration to bring about instructional change lies in the way teachers negotiate their beliefs and practices together.

Study Overview

In this dissertation, I examine teachers' interactions in detail to better understand how teachers collectively negotiate beliefs about teaching, their students, and their academic subject when implementing instructional reforms. This is done in three freestanding chapters, each of which is an article that is under submission or will be submitted for publication.

Chapter 1 is a comprehensive review of literature from the last decade that contributes to an understanding of how collaboration between educators can facilitate changes to their beliefs and instructional practices. In this chapter, I provide a framework for conceptualizing the relationship between teachers' social interactions, beliefs, and instructional decisions and argue that the three elements exert mutual influence on one another. Change in one element can help bring about change in the others, but unless change involves all three, it is unlikely to be deep and sustained. Thirty-three journal articles were reviewed, and an overview of these is located in the Appendix.

Chapter 2 is a qualitative case study of the math departments at two schools undergoing math reforms. The following research questions guide this chapter:

- What attributes of formal collaboration time encourage the expression and deliberation of beliefs regarding the feasibility of reform?
- What attributes of formal collaboration time lead to successful challenges to the belief that reforms are unfeasible?
- What kind of expertise encourages the expression and deliberation of these beliefs as well as successful challenges to the belief that reforms are unfeasible?

Drawing from observation and interview data, this chapter examines the content of teachers' deliberations with one another during their formal collaboration times. Thirty-one formal departmental and grade level math meetings were observed across the two schools and were documented in detailed field notes. Twenty-seven of 28 general and special education math teachers were interviewed in 45-minute semi-structured interviews. I make the case that the kind of discussion that has been shown to support changes in instructional practice often does not occur during formal collaboration, but is more likely under certain structural conditions. This chapter identifies discussion topics and practices that support teacher teams' positive orientation towards reform goals.

Chapter 3 uses the same data set and builds upon the findings of the previous chapter to examine the type of deliberation expertise some individuals posses that can steer conversations in productive ways. The chapter seeks to answer two research questions:

- How does the school context shape the deliberation culture and expertise of the teaching staff?

- How does deliberation support meaningful collaboration between teachers?
- How do teachers use their deliberation expertise to support reform?

Social network analysis and qualitative interview and observation data are employed in this comparative case study to identify contextual factors that support this kind of expertise and maximize its benefits.

This dissertation ends with a reflection on findings across the three chapters and on how this work builds upon prior research. This section includes suggestions for reformers and practitioners as well as questions for future research.

Study Context

Because secondary teachers are often organized in schools by subject-specific departments and grade levels, this study focuses on middle school teachers' school-level, department-level, and subject-specific grade level contexts.

The two case study schools were selected from a wider study of middle school math departments engaged in a reform aimed at guiding teachers to use student assessment data as part of a process of continual improvement. The project was a federally funded partnership grant between a university and school district. In the current era of accountability and high stakes testing, teachers are increasingly asked to use student data to improve instruction, often in collaboration with one another, yet actual data use varies widely between schools, departments, and grade levels. Researchers have noted that teachers' beliefs about their students and themselves are central to how teachers notice and talk about data and instructional practice (Datnow & Hubbard, 2015a), making this project particularly appropriate to draw from for this dissertation study. While attending to numerous other reform efforts, teachers in this study were

asked to use student data during their formal collaboration meeting times to inform instructional decisions. Teachers also received coaching and other pedagogical and curricular support in making instructional changes. Teachers at both schools were simultaneously engaged in other collaborative reform efforts with complimentary goals.

These schools were selected by the district for participation in the broader project due to student achievement in mathematics that lagged behind average in their districts and in the nation. Understanding how middle school math teachers enact instructional reform is of particular importance, as students' middle school math experiences can be influential on their later academic and career opportunities. Students are often assigned to high school math classes based on their performance in middle school, and the math classes students take in high school correlate with their future college attendance and completion and long-term earnings (Rose & Betts, 2004).

These schools were located in the same urban school district in the United States and had diverse student populations, which are described in more detail in Chapters 2 and 3. Although both of these schools had been engaged in instructional reforms for several years, they both struggled to improve student outcomes. Understanding why these schools continued to lag behind expectation requires examining the implementation of reforms at all levels.

Theoretical Framework

Interpretation and implementation of policy is a process by which individuals influence and are influenced by social interactions (Coburn, 2005; Datnow, Hubbard, & Mehan, 2002; Spillane, Reiser, & Reimer, 2002). The social aspect of instructional decision-making helps determine how schools and sub-groups within schools interpret

reforms. Although instructional decisions are ultimately made by each individual teacher, whether teachers make superficial or substantive changes is often determined, in large part, by the way they collectively define aspects of their practice such as the reform itself, their role as teachers, the nature of their subject, and the ability and motivation of their students.

To examine these social aspects of teachers' decision-making, I draw upon the theoretical frameworks of sensemaking and social network theory, both of which are discussed more thoroughly in Chapter 1. Sensemaking theory posits that how individuals and groups actively construct understanding and orient their actions is influenced by their backgrounds and contexts (Coburn, 2001, 2005; Hubbard, Stein, & Mehan, 2006; Spillane et al., 2002). Social network theory looks at the exchange of resources (e.g. expertise, knowledge, attitudes) between individuals in a social network and the formal and informal social position of individuals, examining how the pattern of relationships can support or constrain social exchanges (Daly, Moolenaar, Bolivar, & Burke, 2010). Together, these two theoretical frameworks facilitate a focus on the interactions of educators and the role of beliefs in interaction and in instructional decision-making.

While the literature on sensemaking has long pointed to the importance of social interaction, research on collective sensemaking is less developed (Moolenaar, Daly, Liou, Siciliano, & Bae, 2013). In this literature, themes from social network theory are frequently highlighted (Coburn, 2001; Daly, 2012). Drawing this literature together with social network research and conducting case studies using a sensemaking and social network lens yields new information about the process of teacher collaboration around reform.

Significance

The conversations educators have about instruction and change are often overlooked by reformers and policy-makers. By adding to our understanding of these interactions between educators, this dissertation provides insight into some of the ways reforms can stall or produce meaningful change through teacher collaboration. Understanding how collaboration shapes teachers' beliefs in ways that might encourage positive instructional change can aid researchers and practitioners alike.

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Chapter 1: The Role of Collaboration in Changing Teachers' Beliefs and Instructional Practices: A Review of Literature

The Role of Collaboration in Changing Teachers' Beliefs and Instructional Practices: A Review of Literature

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Abstract

Teachers are often asked to make changes to their instruction, yet these efforts at reform can lead to mixed results. As teachers decide which instructional changes to implement and how to implement them, their beliefs play a central role, and changes to teachers' practice must be accompanied by changes in beliefs. Teachers' interactions with other educators can be pivotal to how teachers negotiate their beliefs and practices. This review draws together research over the last decade that examines the relationship between teachers' collaboration and changes to their beliefs and practices. A conceptual framework is put forth detailing how teachers' interactions, beliefs, and practices can mutually influence one another both directly and indirectly, and recommendations are made for future research and reform efforts.

Keywords: teachers' beliefs, teacher collaboration, instructional change, school reform, teacher learning

The Role of Collaboration in Changing Teachers' Beliefs and Instructional Practices

In recent years, schools have been increasingly under pressure to continually improve student achievement by improving instruction. Many schools have attempted and succeeded in making substantive changes in the last decades. In other schools, instruction may look fundamentally different from one classroom to the next, with some teachers retaining more traditional practices than others (Olsen & Kirtman, 2002; Spillane, 1999).

Because teachers provide instruction to students, they play a key role in enacting reforms aimed at instructional change. Yet even when educators are asked to make the types of changes that research and experience have shown will likely have a positive impact on the needs of their students, these reform efforts often lead to little substantive change in instruction (Cohen, 1990; Spillane, Reiser, & Reimer, 2002).

One factor that can influence instructional decision-making and the enactment of reforms is teachers' beliefs. Although often ignored by those constructing policy, there is considerable agreement among researchers that teachers' beliefs are shaped by experience and play a crucial role in the decisions teachers make (Datnow & Hubbard, 2015; Fives & Buehl, 2012; Kelchtermans, 2009; Richardson, 1996; Spillane et al., 2002). Many studies examine how teachers may willfully or unknowingly alter or fail to implement a reform (Coburn, 2001; Cohen, 1990; Datnow, Hubbard, & Mehan, 2002). Teachers may resist reforms that they feel fail to address the needs of their schools (Tyack & Cuban, 1995), often with good reason, as reforms may not address the underlying challenges of particular settings (Gitlin & Margonis, 1995). In schools undergoing reforms, teachers' beliefs about the need for change is one of the strongest

influences on their implementation of the reform (Czerniak & Lumpe, 1996; Supovitz & Turner, 2000) as teachers are more likely to implement a reform they understand to be coherent and in line with their beliefs (Garet, Porter, Desimone, Birman, & Yoon, 2001). Teachers are more likely to embrace a reform and believe it to be beneficial for their students when they understand it, think that it is in line with their experiences, and feel that it supports their morals as teachers (Schmidt & Datnow, 2005). If teachers' beliefs remain at odds with instructional improvement efforts, little change is likely to occur. Even when teachers intend to implement reforms, changes to instruction may be superficial if teachers accommodate the reform in a way that does not disrupt their existing methods and assumptions (Cohen, 1990). Deeper, more fundamental instructional changes require educators to examine and question their existing beliefs and practices (Wheatley, 2002).

Researchers have noted, however, that teachers do not make instructional decisions in isolation (Daly, Moolenaar, Bolivar, & Burke, 2010; Hubbard, Stein, & Mehan, 2006; Spillane, 1999). Teachers are nested in the context of grade level teams, departments, schools, communities, districts, and wider political systems. Many reforms involve structured collaboration time for teachers given that the benefits of teacher collaboration for school improvement have been well documented over the last three decades (Hargreaves, 1994; Lieberman & Miller, 2011). Many schools ask teachers to work together in professional learning communities (PLCs) where they are expected to engage in a process of inquiry and reflection together toward a shared goal (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006). In other schools, other types of formal and informal collaboration are required or occur organically. Teacher collaboration and

teachers working together in professional communities appears to be a key factor in building teacher capacity and implementing and sustaining educational reform (Coburn, Russell, Kaufman, & Stein, 2012; Daly et al., 2010; Horn & Little, 2010; Marsh, Bertrand, & Huguet, 2015). Yet requiring collaboration is no guarantee that it will occur, and the mere act of collaboration does not guarantee instructional improvement (Hargreaves, 1994; Kelchtermans, 2006; Stoll et al., 2006). Understanding how collaboration can influence instructional change or stability requires deeper consideration of the way teachers' beliefs are shaped by, and shape, the collaborative aspect of reform.

The goal of this review is draw together research to build a conceptual framework of how teachers' beliefs are shaped through collaboration in ways that support instructional change or stagnation. Resting on a body of work which has long established the central role that beliefs play in the instructional decisions teachers make, research from the last decade delves deeper into the way social interactions shape beliefs and practice. The result is a framework, shown in *Figure 1*, that emphasizes the mutual influence between teachers' beliefs, instructional decisions and practices, and interactions with other educators.

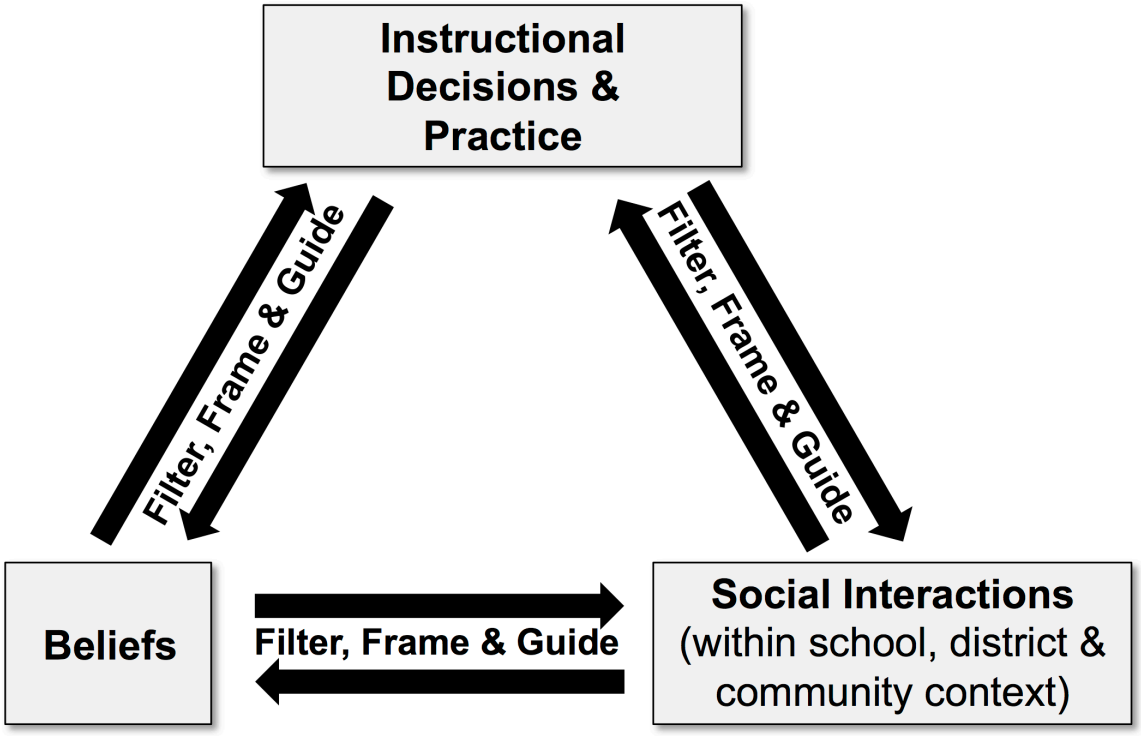

Figure 1. Conceptual framework of the interconnected nature of teachers' beliefs, social interactions, and instructional decisions.

Far from a linear process, the model provides for each component to influence another both directly as well as through the third component. From an examination of the literature, it is clear that each of the three components of the framework exert continual influence on one another, and changes in one area can lead to and be supported by changes in others. Understanding how collaboration shapes teachers' beliefs in ways that might encourage positive instructional change can aid researchers and practitioners alike.

Theoretical Framework

A variety of theoretical perspectives have been used to examine these issues, but this review draws most heavily from sensemaking and social network theories. Sensemaking is particularly helpful due to its emphasis on reform and on the cognitive

processes teachers go through as they make changes to their beliefs and practice. As sensemaking theorists have increasingly placed greater emphasis on the social context of teachers' learning and decision-making, social network theory has become a logical complement for understanding teachers' interactions within wider school structures.

Sensemaking theorists have, over the last few decades, detailed the ways in which teachers come to understand educational reforms in their contexts. Spillane et al. (2002) described the process that teachers go through in interpreting reforms and how teachers' beliefs help shape their actions. To begin with, new policies are interpreted in light of teachers' existing expectations and their intuitive models of students, teaching, and academic subject matter (Cohen, 1990; Spillane et al., 2002). Thus, various teachers interpreting the same reform may be starting from very different understandings of their jobs. Further, aspects of reforms that do not match with teachers' expectations or experience may be rejected in favor of ideas that can fit easily with existing beliefs and practices. This avoids the difficult task of restructuring thinking in favor of an interpretation of a reform that requires only superficial changes. This is not to say that teachers intentionally gloss over differences between the reform and their current practice. Spillane et al. explain that similarities to what is familiar often distract those learning something new. For this reason, teachers implementing a reform in a superficial manner may believe that they have made deeper changes to their practice than they actually have (Cohen, 1990; Spillane et al., 2002). Further, teachers may feel like reforms are at odds with what they believe to be valuable in teaching and learning, or they may feel that reformers are discounting the good work they are already doing. Teachers may feel that a reform contradicts their own experiences or what they already

believe to be true of teaching their subject to their students in their context (Spillane et al., 2002).

Sensemaking theorists have also noted that teachers' social contexts can be central to their understanding of educational change. Teachers can come to very different understandings of their practice depending on who they interact with or whether they work in isolation or with others (Spillane, 1999). Communities filter which information is important and which interpretations are considered valid, and the range of expertise and experience that is part of a community can shape the sense teachers make of their practice (Coburn, 2001; Spillane et al., 2002). In his study on the processes that mathematics teachers underwent to implement an external reform, Spillane (1999) described the pivotal role played by teachers' *zones of enactment*, or the space in which teachers carry out their version of a reform. He described the differences between individual teachers' enactment zones and how those differences situate their sense-making. The extent to which teachers zones were mostly private or included a variety of individuals informed the changes teachers made. When teachers' zones included rich deliberation with other teachers and experts, they were more likely to make instructional decisions that involved substantial changes to their practice. Through deliberation with others, teachers are exposed to varying beliefs and ideas and need to grapple with how these fit in with their own experiences and beliefs. It is in these interactions that problems are framed and information is validated or ignored (Spillane, Kim, & Frank, 2012). Therefore, moments of collaboration can be pivotal to reform efforts.

Simply requiring teachers to collaborate, however, is not guaranteed to promote instructional change. Using a sensemaking framework, Coburn (2001) explained how

teachers' beliefs can influence their social interactions. She found that teachers interacted on an informal basis with others who shared similar worldviews to themselves, and these groupings were more influential than formal groupings in how teachers interpreted reforms. Further, these informal groupings tended to be too homogenous to include the kind of range of experience and expertise that is conducive to meaningful deliberation. Thus, teachers' grouped according to their beliefs, and their understanding of the reform varied by group and was reinforced by that grouping. When teachers interacted across worldview in formal groupings, they were often unable to understand each other's perspectives enough to engage in fruitful discussions.

These interactions, both formal and informal, are the focus of social network theory, which facilitates a focus on the capacity of organizations that exists in social relations rather than in individuals or organizations (Farley-Ripple & Buttram, 2015). Social network theory posits the social structure of a group and an individual's position within that structure has implications for how information, ideas, and beliefs are shared (Daly, 2012). Attributes of the social network such as its density, centralization, strength of ties, and reciprocity of ties can affect how quickly resources and ideas are shared by individuals, to what degree they are shared, and who exerts the most influence over what is shared and how (Daly et al., 2010). Social network researchers have identified, for example, that although highly centralized networks might be useful for disseminating some types of information, they also may have more difficulty in dealing with change (Moolenaar, Daly, & Sleegers, 2010). Similarly, dense networks (those with many ties between individuals) are associated with more willingness to take risks for school improvement (Daly et al., 2010; Moolenaar et al., 2010). Social network analysis can

account for both formal and informal relationships between individuals, the strength and nature of those relationships, and the direction that information and ideas flow (who is giving and who is seeking or receiving those resources).

When combined with sensemaking, a social network perspective can add valuable insight into the otherwise hidden relationships and exchanges between individuals, and the nature of the overall social structure of a group. In looking at how teachers collectively negotiate their beliefs and practices, these two frameworks help account for instructional change or stagnation.

Method

This review of literature includes only published research that meets three criteria. First, the research must speak to how collaboration between educators can facilitate changes to beliefs in ways that support or constrain instructional change. Second, reviewed pieces were published in the last ten years. Finally, only peer-reviewed literature was included. Although not all of the research was conducted in the United States, all pieces were published in English. Only one reviewed piece does not discuss the role of collaboration or social interactions, and that piece is included here because it adds depth to our understanding of the relationship between beliefs and practice in a reform context. Five pieces do not discuss beliefs, but they provide insight into how teachers discuss and deliberate change, which is central to negotiating beliefs. An overview of the reviewed research can be found in the Appendix.

To begin, terms such as: *teacher beliefs, teacher learning, instructional change, instructional decisions, teacher collaboration, teacher learning, professional learning communities, communities of practice, school improvement, school change, school*

culture, and *instructional improvement* were entered into search engines, primarily Google Scholar. Many of these terms yielded mostly results falling outside of the scope of this review (such as work that did not have a strong reform element or work that did not speak to teachers' beliefs), so terms were often combined. Additional sources were recommended by colleagues. References of the reviewed publications were checked for relevant literature, and publications that cited the reviewed literature were also checked for inclusion.

This review draws upon qualitative, quantitative, and mixed methods research, as well as literature reviews. Most sources include some qualitative methods as they are well-suited to understanding teachers' beliefs and contexts. In all, 33 journal articles were reviewed, including six reviews and one theory-building essay. The Appendix provides an overview of the studies included in this review. Additional works – particularly books and older articles – were used as foundational references on particular topics, and appear mainly in the introduction to this study and throughout when they provide strong support for the findings of more recent studies. The findings are organized in a way that allows lessons from the literature to build our understanding of the topic at hand. Concepts from the articles (rather than articles in their entirety) were grouped in a way that provides a useful framework for researchers and practitioners.

This review is not exhaustive. The intent was not to review every relevant piece of literature, but instead to build our understanding of how the three components of the theoretical model operate on one another directly or indirectly when teachers collectively negotiate beliefs and instructional practices.

Results

Deliberation with other educators appears to be a central mechanism by which teachers make sense of their contexts, thereby encouraging instructional change or stagnation. The conceptual framework put forth in *Figure 1* emphasizes the ways in which this social interaction, beliefs, and instructional decisions shape one another. This framework builds upon the complex systems approach Opfer and Pedder (2011) used to describe teacher learning, but places greater emphasis on teachers' instructional decisions and the resulting change or stagnation in instructional practice. Fives and Buehl's (2012) explanation of the function of teachers' beliefs is expanded to explain the way of all three aspects of the conceptual framework inform one another. This review focuses specifically on the role of social interactions in shaping teachers' beliefs in ways that support instructional change. Because changes to beliefs and practice must go hand in hand, the first section of this review explores this relationship in the context of reform. Following that are lessons from recent research on the social negotiation of beliefs, how these negotiations matter for instructional change, and how the context of these negotiations can influence changes to beliefs and practice. Taken together, this work helps build our understanding of the social aspect of changing teachers' beliefs and practice, providing useful insights for future reform attempts.

Instructional Change Must Include Changes to Both Teachers' Practice and Beliefs

A teacher's practice is bound by what that teacher believes to be possible (Fives & Buehl, 2012; Horn, 2007). In their review of the nature and function of teachers' beliefs, Fives and Buehl (2012) identified three ways beliefs help shape the way teachers perceive and act on their contexts. They described beliefs as a) filters that influence what

teachers notice and how they interpret and internalize that information, b) frames that structure how teachers define problems and c) guides that shape teachers' actions. These functions of beliefs help explain how teachers in the same school might come to very different understandings of what types of changes are necessary or possible for their students.

The importance of attending to teachers beliefs along with their capacity to engage in reform is highlighted in Datnow and Hubbard's (2015) review regarding reforms aimed at having teachers use student data to improve instruction. They note that teachers' beliefs regarding a reform may provide encouragement or reluctance to fully participate with the reform, and that simultaneously attending to teachers' capacity to participate in the reform can give teachers both the desire and tools to make successful changes.

If we understand changes in beliefs and practice to be a type of learning, Opfer and Pedder's (2011) description of teacher learning provides valuable insight into this process. They describe learning as involving "ongoing transformations, simultaneously, of both knower and knowledge" (p. 388). They explain that change is not simply a matter of a teacher learning the content presented during professional development sessions, nor simply a reorganization or change in practice. Teachers must, at some point, change both their beliefs and their practice. Many studies have found that teachers gravitate towards learning experiences that already align with their beliefs (Hill, Beisiegel, & Jacob, 2013; Opfer, Pedder, & Lavicza, 2011; Spillane & Miele, 2007; Timperley & Alton-Lee, 2008; Wheatley, 2002). Teachers may be open to new types of learning experiences, however, as their beliefs begin to change (Opfer & Pedder, 2011;

Timperley & Alton-Lee, 2008). Likewise, teachers' beliefs can change as a result of changes to their practice (Bandura, 1997; Gallimore, Ermeling, Saunders, & Goldenberg, 2009; Guskey, 2002). How that occurs likely involves a complex interplay between teachers' beliefs, practices, and student outcomes, as well as between teacher, context, and learning activity. Because each teacher and each school is unique, professional development and proposed avenues for reform must be flexible enough to meet the needs of a variety of teachers and students in various contexts.

Some beliefs are more difficult to restructure than others. Fives and Buehl (2012) describe a continuum of the stability of beliefs with the most stable being those that are long-held and deeply integrated with other beliefs. Newer, isolated beliefs are easier to change. Further, they explain that changing beliefs and gaining knowledge must go hand-in-hand in order to be meaningful. Yet, the line between knowledge and beliefs is not easy to draw (Kelchtermans, 2009), as demonstrated by the process that teachers go through in understanding reforms.

Teachers' beliefs about reforms may be particularly strong and integrated as they often involve a sense of self. Teachers' beliefs about what it is to be a good teacher are a deeply personal part of their identities and self-esteem (Kelchtermans, 2009), and may seem to be under attack by reformers seeking to change teachers' practice. If teachers believe that reforms go against their personal experience as practitioners, they are unlikely to restructure their beliefs to accommodate a reform (Kelchtermans, 2009). Attempts to change these highly integrated beliefs can involve emotional responses from teachers. Reform attempts can also lead to feelings of anxiety and frustration if teachers do not fully understand the reform or if it seems contradictory or vague (Schmidt &

Datnow, 2005).

It is useful to think about reform implementation as an ongoing process to understand how beliefs and decisions shape one another. Any expectation of teacher learning must come with the understanding that change is gradual and requires teachers to spend extra time and effort and risk worse student outcomes. However, when teachers take the step to make changes in instruction, their understanding about a reform can change as they assess the results of instructional changes (Guskey, 2002). As teachers see changes in student performance following changes in instructional practices, they can begin to attribute student performance to instruction rather than to uncontrollable external factors (Gallimore et al., 2009). This can result in shifting beliefs about students and teaching.

Although shifts in practice can lead to shifts in beliefs, they are not guaranteed to do so. Oláh, Lawrence, and Riggan (2010) described the role teachers' beliefs played in their interpretation of student outcomes amidst a reform aimed at using assessment data to help teachers monitor students' progress. Although the reform was aimed at measuring all students' progress towards common academic goals, teachers interpreted the results differently for different students, classes, and times of year. This illustrates that the process of shifting beliefs and practice is not linear and is influenced by multiple forces.

Changes to beliefs and practice are inexorably linked, and shifting one can engender a shift in the other. Understanding the conditions under which reforms can encourage this change, however, requires acknowledging that teachers work in wider school and community contexts, all of which help shape their beliefs and practice.

Beliefs are Negotiated Socially in Formal and Informal Settings

Prior work, discussed in the introduction, has established that teachers' interactions with one another and with other educators play a role in how they make sense of their contexts (Coburn, 2001; Spillane, 1999; Spillane et al., 2002). Social interactions can make a difference in how teachers interpret reforms, the sense they make about conflicting beliefs and the way they interpret results of changes. Teachers' formal and informal professional communities play a central role in shaping teachers' beliefs given that beliefs about students and teaching often change when teachers are afforded sufficient time and an environment that supports open deliberation. Having opportunities to deliberate with colleagues is repeatedly cited as one of the most important ways teachers make sense of their practice and shift their beliefs (Coburn, 2001; Spillane et al., 2012).

Increasingly, reforms aimed at changing instructional practice incorporate some kind of formal collaborative component, sometimes with great succes. Gallimore et al. (2009) documented the ways teachers beliefs shifted when they were engaged in a formal collective inquiry process. They found that when teachers worked together over extended periods with shared goals on instructional problems, their attributions for student success and failure began to shift as they saw changes in student outcomes. Allen and Penuel (2015) found that formal opportunities for teachers to collectively make sense of reforms were crucial to the ability of teachers to reconcile perceived conflicts between the reforms and their existing contexts. In studying the formal collaboration times of math teachers engaged in a 5-year reform, Gresalfi and Cobb (2011) noted that teachers came to identify with the reform goals as they collectively negotiated their motivation for

teaching and for reform. Building in formal time for collaboration around reform, then, can aid the process of educational change.

Attending to the underlying relationships in formal collaborative groups, however, appears to be important for fostering productive collaboration. Stein and Coburn (2008) examined how districts used formal collaboration structures to provide teachers with opportunities to learn in order to improve instruction. They found that building reform-related collaboration around existing collaborative relationships provided more meaningful discussion than did district-created collaborative structures. Furthermore, informal interactions also appear to matter. In their study of high school teachers' attitudes about their schools' reforms, Cole and Weinbaum (2010) used social network analysis to examine the influence of the different types of social networks teachers belonged to. They found that attitudes about the reform were not only influenced by teachers' direct interactions with colleagues, but also by the interactions their colleagues had with others. In other words, the attitudes of the friends of their friends were influential to the attitudes they held themselves. In fact, these indirect interactions through their existing networks were as influential to their attitudes about the reform as were their direct interactions with peers. Although this study was done early in the reform effort and the authors caution that teachers' reform networks may become more influential as time goes on, it is clear that social networks play a role in the beliefs that teachers hold. In fact, this study found that peers had a greater influence on teachers' attitudes than did factors such as experience, departments, and formal titles.

Far from being static possessions of individuals, beliefs are expressed and negotiated with others. These formal and informal opportunities to deliberate matter for

how these beliefs take shape. The consequences of these deliberations are examined below.

How Beliefs are Negotiated Socially Matters for Instructional Change

Because the informal and formal interactions of teachers can exert such influence on the beliefs teachers hold, social network analysis is increasingly used to shed light on this relationship and its role in instructional change. When reforms are introduced in a school, social networks develop surrounding the reform. In the mixed methods study by Daly et al. (2010), the density of schools' and grade-levels' reform-related social networks were found to be related to the depth and breadth of reform and to groups of teachers' sense of efficacy regarding reform. This study also found that teachers working to implement the same reform in different grade level groups with different levels of collaboration were enacting the reform differently. Similarly, in their social network study of schools undergoing reform, Moolenaar, Sleegers, and Daly (2011) found that the social networks of different grade levels within schools played a role in the way teachers understood and enacted the reform. Teachers in some grade levels spent more time and had more interactions than others around improving practice and developing lessons in relation to their school's reform.

Further, teachers' social networks are shaped by their beliefs, promoting or limiting opportunities for teachers to learn about reform efforts. In looking at teachers' beliefs about the Common Core State Standards (CCSS), Moolenaar, Daly, Liou, Siciliano, and Bae (2013) found that teachers' interactions with colleagues about the reform were limited by the beliefs they held. Teachers were more likely to seek discussions about the CCSS if they held positive beliefs about the reform, and they were

more likely to discuss the topic with others who held similar efficacy beliefs. Teachers who held negative beliefs about the CCSS, then, did not have the same kinds of opportunities to deliberate with colleagues around the reform, limiting their exposure to a range of understandings and expertise that could influence the way they implement the new standards. Farley-Ripple and Buttram (2015) also found that teachers' interactions were shaped by their beliefs. Teachers who were engaged in a reform surrounding data use were more likely to seek advice from colleagues who they believed held expertise on the topic. It was through this network based on teacher perception that teachers developed their capacity for data use. Reform networks have also been found to be shaped by teachers' beliefs on expertise, thereby influencing the social opportunities they have to make sense of reforms (Moolenaar et al., 2013).

The iterative relationship between teachers' beliefs and instructional decisions resides, in large part, in the conversations teachers have with one another. Over the past decade, researchers have paid increasing attention to the ways teachers negotiate beliefs in ways that promote instructional change or stagnation. The ideas, expertise, beliefs, and motivations of individuals help shape what ideas are up for discussion, how they should be discussed, and what decisions are acceptable or even possible. Underlying these beliefs may be very different assumptions that go unnoticed, yet form the basis of what is or is not considered to be possible and appropriate for students (Hubbard et al., 2006). In addition to holding beliefs that may conflict with those of other teachers, individual teachers frequently hold multiple conflicting beliefs or beliefs that conflict with their practice (Fives & Buehl, 2012; Park & Datnow, 2017). Who teachers interact

with and the nature of those interactions helps determine which beliefs are expressed and privileged.

In studying teachers' conversations during formal collaboration times, Horn and colleagues (Horn, 2007; Horn & Kane, 2015; Horn, Kane, & Wilson, 2015) have found that teachers' conversations can be opportunities for learning or, at other times, obstacles to change. Although teachers likely held a variety of beliefs about student ability and motivation, the nature of their academic subject, and the role of teachers, the way these beliefs were voiced in formal collaborative meetings framed the instructional practices teachers believed to be appropriate.

In Horn's (2007) study of high school math teachers' discussions during an equity-based reform, the way teachers talked about student ability and motivation was tied to beliefs about math and had implications for the instructional practices they felt were appropriate for their students. In this study, the team of math teachers who operated under the assumption that their subject consists of a sequential body of knowledge and procedures explained their students' success or struggles in terms of ability and motivation. They viewed students' previous poor math performance as an indication that students were unable or unwilling to take on tasks that were cognitively challenging. Meanwhile, the team that held a nonsequential view of math to which each student brings different strengths and weaknesses looked for explanations of students' performance that involved instruction and curriculum, placing the burden of improvement on teachers' instruction rather than on students.

Similarly, in their study of secondary mathematics teacher workgroups, Horn and Kane (2015) documented the differences in how math teacher groups framed the task of

planning depending on the beliefs they held about math. Teacher groups that believed planning involved pacing their classes to cover a body of material made different types of instructional decisions than those who framed the task of planning as figuring out how to build upon their students' current understanding. If a teacher's job is to pace the year to ensure coverage of sequential topics, building up to a complete body of mathematical knowledge, then task selection, instructional methods, and assessment are all likely to be shaped by this frame. On the other hand, students may experience a very different type of instruction and assessment from teachers who believe their job is to help students construct an understanding of mathematics by exploring a network of ideas.

Although not all of the teachers in these groups completely shared the beliefs under which their teams operated, groups negotiated which beliefs framed their discussions, filtered which aspects of teaching were relevant to their collaboration, and guided their instructional decisions. It is clear, then that how beliefs are negotiated socially, and the opportunities teachers do or do not have to engage in these deliberations, can have noticeable ramifications for classroom instruction. How certain beliefs were given voice over others has to do with the wider context of teachers' collaborative discussions.

Deliberation of Beliefs is Limited by the Context of the Collaboration

Given the power of teachers' conversations to shape belief and practice, it is not surprising that many reforms involve putting structures in place that enable and encourage fruitful collaboration. Although formal groupings have their limitations, structured collaborative time is a key (though insufficient) support for the kind of discussions that shape teachers' ongoing learning (Coburn & Turner, 2011; Opfer &

Pedder, 2011; Resnick & Scherrer, 2012). Teachers' discussions can be shaped by how teachers are grouped (Horn & Kane, 2015), what time they are given for collaboration (Horn et al., 2015), what goals and expectations are in place for their time (Datnow, Park, & Kennedy-Lewis, 2013), and what materials they are given (Horn et al., 2015). Thus, although a school does not dictate teachers' beliefs or instructional decisions, their structures can influence them for better or for worse.

Research on school reform in the last decade builds upon prior research on school culture and improvement. Aspects of teachers' contexts that promote change over stability have been studied in depth and include whether a group holds a collective orientation towards learning (Opfer & Pedder, 2011; Stoll & Fink, 1996), supports beliefs that learning goals can be attained (Stoll & Fink, 1996), is structured to support collective learning and practice (Hargreaves, 1994), has a practice of reflection (Opfer & Pedder, 2011), acknowledges the wide range of expertise of staff and the ability of others to access those (Cornelissen et al., 2014; Opfer & Pedder, 2011; Pedder & MacBeath, 2008), supports risk to allow innovation (Moolenaar et al., 2011), has a structured approach to ongoing teacher learning (Opfer & Pedder, 2011), is focused around shared goals (Schildkamp & Poortman, 2015), and perceives a disequilibrium between what they desire and believe to be possible and what they believe is actually taking place (Opfer & Pedder, 2011; Timperley & Alton-Lee, 2008). Researchers, then, are in clear agreement that substantive change is more likely in a collaborative, trusting environment where teachers support one another's innovations and reflect upon them.

If trust and support are important for the type of deliberation teachers need in order to restructure their beliefs and practice, how conflict is dealt with in a teacher's

context can have a profound effect on the types of collaboration a teacher may be able to access. Communities must balance conflict with maintaining strong ties between individuals (Kelchtermans, 2006). One mechanism for avoiding conflict that also promotes stability over change is upholding norms of privacy that help shape how much of their practice teachers actually share with one another (Coburn & Turner, 2011). If teachers do not share their practice, their discussions are unlikely to delve deep enough to encourage changes to beliefs and practice. Norms and routines delineate what type of information is worthy of attention and how problems should be addressed (Coburn & Turner, 2011; Horn & Kane, 2015; Spillane et al., 2002).

In an attempt to create more improvement-oriented climates, some schools or groups within schools attempt to establish their own norms around a reform. These, however, may not be enough to overcome a preexisting lack of trust among teachers (Datnow et al., 2013). "Collaboration," writes Kelchtermans (2006), "often appears only to the extent that it does not threaten cultural norms or the relationships of power and influence among the team" (p. 233). Changing collective norms, like changing other types of beliefs, may then be a necessary but difficult step towards substantive change in practice. If a school has a strong tradition of teachers working in isolation or collaborating on a superficial level only, simply mandating collaboration might make little difference (Datnow et al., 2013; Horn & Little, 2010). Likewise, if participants are only oriented towards their collective goals during their specified collaboration times, they may not follow through with joint decisions (Spillane, 2012).

Collaboration may also serve to reinforce existing beliefs and practices that do not support improved student learning (Horn & Kane, 2015; Spillane et al., 2012). If a

collaborative team is too homogenous and does not include a variety of skills and ideas, the team has little to work with to imagine and enact changes. It is also possible that, although diversity may exist, certain beliefs and practices are privileged above others and dissent and discussion are discouraged, or teachers may simply wish to avoid conflict (Coburn, 2001; Watanabe, 2007). In these cases, collaboration may work against instructional change or even lead to undesirable changes (Spillane, 2012). The quality of collaboration, then, mediates the opportunities of teachers to alter their beliefs and the types of instructional decisions teachers make. Likewise, the individuals within the context of the interaction are integral to the resulting decision-making.

Aspects of Collaboration that can Foster or Constrain Changes to Beliefs and Practice

Given the importance of teachers' conversations to their beliefs and practice, the quality of these conversations should be of utmost concern to those who are trying to enact change. The expertise of those participating in the discussion can strongly influence the discussion's depth, as can the leadership at a school, a group facilitator or coach, and the tools available to teachers during discussion.

Instructional change requires access to expertise. In order to increase the likelihood that teachers' conversations will include the type of discussion that enables changes to belief and practice, access to expertise is vital to teachers' collaboration. Teams of teachers who lack expertise may be unable to focus their conversations around instruction or may reinforce ineffective classroom practices (Horn & Kane, 2015; Marsh et al., 2015).

Horn and Kane (2015) studied math teachers' unfacilitated teacher workgroups with varying levels of expertise. They found that the group with greater expertise tended to have conversations about classroom practice that were richer and took students' understanding into account. Their conversations were marked by replays and rehearsals of interactions with students, bringing classroom practice into the workgroup conversation and breaking down norms of privacy. They also connected ideas about teaching, math, and student thinking more frequently than did the less sophisticated groups. The group with the least expertise focused more on the pacing of the curriculum and spent little time discussing examples of their own classroom practice. Therefore, the workgroups themselves afforded the expert teachers with opportunities to deliberate deeply and to learn that the less sophisticated groups did not have. Unfacilitated collaboration, then, may only facilitate instructional improvement when there is sufficient expertise available in the group itself.

One way schools seek to raise the level of expertise available to teachers is to bring in outside experts. Schools that focus only on the expertise they already possess run the risk of stagnation without the benefit of outside influence (Opfer & Pedder, 2011; Timperley & Alton-Lee, 2008). Additionally, when internal teacher beliefs and practices are not challenged by outside ideas, new teachers and teachers who would like to deviate from or who disagree with the predominant school beliefs and practices may find that their voices are not heard (Kelchtermans, 2006) or they may simply become acculturated into the predominant beliefs and practices (Opfer & Pedder, 2011). However, schools that are overly reliant on outside experts may stifle the diversity of opinion and autonomy of the teachers (Opfer & Pedder, 2011). Researchers have long warned that teachers at a

school need to buy in to a new practice and be active participants or the new practice runs a high risk of failure (Datnow et al., 2002). Thus, research suggests that the level of internal and external expertise needs to be carefully balanced when teachers are asked to adopt new beliefs of practices.

Leadership maintains a strong influence over interactions between teachers. The conditions within which teachers collaborate are usually, in large part, established by a school principal or other administrator. The power of formal leaders can be seen through social network analysis. Instructional advice and discussions about classroom reforms most often originate from formal leaders (Moolenaar et al., 2013; Spillane et al., 2012), affording them a great deal of power in framing policies and practices according to their own beliefs.

Using a sensemaking framework, Coburn and colleagues have outlined the large part school leaders play in the degree of success of reform efforts (Coburn, 2005). Leaders establish formal groupings of teachers and select which policy messages teachers should attend to (Coburn & Turner, 2011). Further, leaders filter policy messages for teachers according to their own understanding and priorities (Buttram & Farley-Ripple, 2016; Coburn, 2001). Leaders carry more power in interactions than do teachers, so when there is a discrepancy in how individuals interpret a situation, the leader's perspective is usually given greater voice and authority to shape the conversation (Coburn & Turner, 2011). Leaders can also purposely or unknowingly frame policies and activities to serve particular ends which influences the beliefs teachers form and the decisions teachers make (Marsh et al., 2015; Park, Daly, & Guerra, 2013).

Because formal teacher groupings are often determined by principals or other administrators, these leaders can have a lasting influence on teacher collaboration even when they are not present during discussions. Collaborative efforts are more likely to be successful when administrators carefully consider teachers' expertise, experience, beliefs, and social networks (Brezicha, Bergmark, & Mitra, 2015; Farley-Ripple & Buttram, 2015; Horn & Kane, 2015; Stein & Coburn, 2008). The degree of flexibility principals give to teachers interpreting policy also influences outcomes. Fruitful deliberation can occur when teachers have some degree of flexibility in how they interpret policy, but too much can lead to confusion and a lack of direction (Brezicha et al., 2015; Datnow et al., 2013).

Coaches can facilitate meaningful deliberation. Teams of teachers may not possess the kind of expertise necessary to create substantive change, but the addition of a coach or group facilitator can help deepen their discussions. These types of leaders can focus discussions in ways that have been shown to lead to changes in instruction, including focusing on outcomes rather than intentions (Park et al., 2013), on instructional practices (Coburn & Turner, 2011; Gibbons & Cobb, 2016; Marsh et al., 2015), or on student understanding (Cosner, 2011). Coaches can help teams avoid the tendency to share strategies without deliberation and, instead, help teachers restructure their thinking and combine their ideas with purpose (Marsh et al., 2015). Without a coach or other skilled facilitator in a supportive setting, groups who lack expertise or who want to avoid conflict between members with very different beliefs may never have the types of discussions that challenge long-held beliefs.

Coaches can also help sustain continued teacher learning over time. Mayer, Woulfin, and Warhol (2014) described the way a coach from an intermediary organization helped elementary school teachers believe that they were capable of create and carrying out reforms. In this way, coaches can help teachers not only alter beliefs about students and practice, but about the role of teachers as well.

Objects can act as an additional voice in conversations. An often-overlooked voice in teacher discussions is that of the tools or documents brought to conversations such as textbooks, pacing guides, or assessment reports. These objects are representations of ideas that teachers encounter and interact with, giving them weight and meaning (Stein & Coburn, 2008; Wenger, 1998). The way these objects are written often implies a particular stance by drawing teachers' attention to certain information, grouping concepts together, or omitting certain information altogether. Teachers discussing benchmark assessment data, for example, might see student results presented in categories or grouped according to topics that teachers then subsequently use in their discussions (Horn et al., 2015). Such assessment reports may present data in a way that enables teachers to understand student thinking, or may include only information that does not give teachers any clues as to how to alter their instruction. Indeed, Farrell and Marsh (2016) found that middle school teachers came to different conclusions about the types of instructional decisions that were appropriate following collaborative analysis of different types of data (district benchmark assessments, grade-level assessments, and student classwork). Their perceptions of the validity and usefulness of data varied by its type, and their conversations were framed differently depending on the data available to

them. These types of objects have the power to shape the types of conversations teachers have, directly influencing the array of possible decisions they make.

Objects brought to discussions, school leadership, group facilitators, and teacher expertise are variables that are, to some degree, controllable. They are aspects of social interactions that play a role in how beliefs are negotiated and which instructional decisions are deemed appropriate.

Conclusion

Research over the last decade has made a strong case for attending not only to teachers' beliefs, but also to the way these beliefs are negotiated in social contexts when attempting instructional reform. Researchers have noted that peer interactions help shape what teachers notice, what they believe to be appropriate to discuss with each other and attempt with students, and how they frame their tasks (Cole & Weinbaum, 2010; Horn & Kane, 2015). Further, differing levels of power and authority and the range of beliefs and knowledge of the individuals in a group can all impact norms that help frame teachers' thinking (Coburn & Turner, 2011). The organizational structure, culture, norms, formal and informal positions of power and authority, available tools and resources, and the social networks of their contexts can all impact teachers' decisions and their beliefs (Daly et al., 2010; Datnow et al., 2002; Opfer & Pedder, 2011; Spillane et al., 2002).

The theoretical model put forth by this review (*Figure 1*) captures the influence social interactions, beliefs, and instruction have on one another both directly and through each other component. How teachers notice, interpret, and act on each of these elements is largely dependent upon the filtering, framing, and guiding of the others. Thus, if changes to practice must be accompanied by a change in beliefs, then how these beliefs

are deliberated in social contexts is of utmost concern. In attempting to explain why reforms can sometimes lead to instructional change and other times fall flat, understanding the social context and beliefs through which those reforms are filtered, framed, and guided is imperative. Focusing only on instructional change itself without looking at the other elements of the framework is unlikely to provide researchers or practitioners with useful information to guide successful instructional improvement.

The hopeful message contained in this research is that there is great potential for promoting changes to beliefs on which we have not yet capitalized. Under the right conditions, it is possible for people to change their conceptions about teaching and learning, laying the way for desirable changes to instruction and, ultimately, improved student learning. Yet mere time for collaboration is not enough. Questions about how that time should be structured and who should be present are important ones for practitioners and researchers alike.

In order to optimize teachers' collaborative time, more research that looks closely at this aspect would be useful. Future studies are needed that attend closely to examples of shifts to beliefs in the course of teachers' interactions and to the influences on those shifts. What occurs in some interactions that allows undesirable beliefs to be successfully challenged or silenced in favor of reform-oriented ones? Are there structural components of schools or reforms that can promote these aspects of collaboration in favor of those that impede change? Future research can delve deeper into questions about how teachers' contexts can shift teachers' beliefs and instructional practices and be leveraged for instructional improvement.

Chapter 1 is currently being prepared for submission for publication of the material.

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Teachers' Deliberation of Beliefs to Support Instructional Reform

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Abstract

Teachers collectively negotiate beliefs in ways that support or undermine efforts at instructional reform, often impacting the way reforms are implemented in classrooms. This study examines teachers' dialogue during formal collaboration times to see how teachers' beliefs are voiced and deliberated in ways that portray reform efforts as feasible or not. Math departments of two low-performing middle schools undergoing reforms were observed during formal collaboration meetings, and teachers were interviewed to identify patterns across teachers' discussion topics and groupings that related to the voicing and deliberation beliefs about the reform goals. Discussions about student tracking and accountability data involved frequent statements that supported the belief that reforms were not feasible in these schools. Discussions about student thinking on particular math topics and corresponding instructional strategies not only involved the voicing and deliberation of more varied beliefs, but these topics were also used by several individuals to challenge negative statements about the feasibility of reforms. Certain individuals were more likely to express and/or deliberate beliefs than others, and deliberation strategies that included details about math-specific teaching practices were more likely to be successful in supporting reform goals. Teachers were more likely to engage in deliberation of their beliefs when they were in trusting environments that did not involve strong norms of privacy. These findings yield important implications for educational reform and for future research.

Teachers' Deliberation of Beliefs to Support Instructional Reform

Attempts at school reform aimed at improving instruction are common, but often unsuccessful (Cohen, 1990; Spillane, Reiser, & Reimer, 2002). Teachers are an integral part of instructional reform, and prior research highlights the centrality of teachers' beliefs to the way they understand and implement reforms (Datnow & Hubbard, 2015a). Because collaboration between educators has been shown to make a difference to both their practice and beliefs (Allen & Penuel, 2015; Coburn, 2001; Gresalfi & Cobb, 2011), many reforms include formal structured time for teachers to work together, often with mixed results (Hargreaves, 1994; Stoll, Bolam, McMahon, Wallace, & Thomas, 2006).

The relationship between teachers' beliefs, practice, and collaboration is not linear or uni-directional, as each can influence the others (Fives & Buehl, 2012; Gallimore, Ermeling, Saunders, & Goldenberg, 2009; Guskey, 2002; Opfer & Pedder, 2011; Spillane et al., 2002; Wheatley, 2002). We know little about how this relationship plays out in real time in schools where teachers are grappling with reform. This study zooms in on teacher dialogue during formal collaboration times to provide an in-depth look at how beliefs are voiced and negotiated.

The opportunity to deliberate with colleagues has been repeatedly cited as a way for teachers to make sense of their practice, to understand reforms, and to negotiate beliefs (Coburn, 2001; Spillane, 1999). This study, therefore, seeks to answer the following research question: *How does formal collaboration time support deliberation of and challenges to teachers' beliefs in schools undergoing instructional reform efforts?*

Researchers have identified beliefs that have implications for the collective decisions teachers make, as well as some aspects of teachers' formal collaboration time

that can encourage deliberation. This paper begins by examining prior research on teachers' collaborations and beliefs in the context of instructional change. It then examines the formal collaborations of teachers in two schools undergoing reforms in order to shed light on the role of the context of teachers' interactions in the deliberations they have about the feasibility of the reform goals.

The theoretical framework of this study focuses on the dynamic social aspect of beliefs. Rather than attempting to drill down the extent to which beliefs are static possessions of individuals, this study proceeds from the standpoint that individuals and groups can operate under a number of conflicting beliefs (Fives & Buehl, 2012). Beliefs can be expressed and negotiated in groups as attributions, framings, interpretations, and attitudes that are voiced, implied, accepted, and debated differently depending on the social context (Coburn, 2001; Gallimore et al., 2009; Horn, 2007; Jackson, Gibbons, & Dunlap, 2016; Spillane et al., 2002; Windschitl, Thompson, & Braaten, 2011). Therefore, this study does not seek to label the beliefs held by individual teachers, but instead looks at how beliefs are voiced and challenged in relation to the social context of the meeting to better understand how certain beliefs become accepted over others.

Literature Review

As educational reformers increasingly include structured collaboration time as an element to help teachers make changes to their instruction, how teachers collectively negotiate beliefs about their practice in these groupings must be central to our understanding of reform. The ways these beliefs filter, frame, and guide teachers' conversations and decisions matter for the instructional practices they deem appropriate for their students (Fives & Buehl, 2012). This section outlines prior research on how

teachers' beliefs make a difference for the instructional decisions they make with colleagues, followed by a discussion of how teachers' interactions can encourage the kind of deliberation that has been shown to support instructional change.

Teachers' Beliefs and Collaboration Around Instruction

Researchers have documented how the beliefs teachers hold about their students, about teaching, and about the subject they teach make a difference to how they interpret their contexts and the decisions they make. These three topics of beliefs are explored in detail below, followed by a discussion of the attributes of collaboration that encourage the kind of deliberation that might support changes to teachers' beliefs and practices. Special consideration has been given to math teachers as they are the focus of this study.

Beliefs about student ability and motivation. There are a number of explanations that teachers may have for why a student does or does not succeed in a particular task, but one common topic of discussion in teacher meetings is whether a student is able and willing to do so. Here, beliefs about the nature of intelligence hold enormous potential to shape instructional decisions. Teachers who believe that intelligence is fixed and innate are more likely to support practices such as "tracking" students (Oakes, Wells, Jones, & Datnow, 1997) or avoid inquiry-based practices that they worry are too difficult for their students (Horn & Kane, 2015). Conversely, teachers who believe that intelligence is malleable are less likely to categorize their students according to ability (Horn, 2007). Similarly, teachers sometimes explain student struggles as a consequence of a student being able yet unmotivated (Hansen-Thomas & Cavagnetto, 2010; Horn, 2007). Belief in such categories can shape the way teachers

view the appropriateness and success of reform efforts (Oláh, Lawrence, & Riggan, 2010; Park & Datnow, 2017).

Teachers sometimes attribute student performance to stable characteristics of a student or group of student. In studying teachers' use of student assessment data, Bertrand and Marsh (2015) found that teachers sometimes explain student results by citing student membership in a group such as special education or English Language Learners. Research has found that teachers can hold low expectations for students in these groups or believe that these students have little control over their performance (Cook, Tankersley, Cook, & Landrum, 2000; Pettit, 2011; Woolfson & Brady, 2009). This could have consequences for teachers' beliefs about what type of instruction is appropriate for particular students.

Beliefs about math. Teachers' instructional decisions are influenced not only by their beliefs about students, but also by their beliefs about the subject they teach. Often, teachers' beliefs about their subject inform the beliefs they hold about their students, about teaching, or about instructional change. For example, secondary math teachers have been shown to differ in their beliefs about the purpose of learning math and the processes involved in that learning, thereby informing their instructional practices and interpretations of reform efforts (Handal, 2003).

Horn's (2007) study of high school math teachers' discussions during an equity-based reform illustrates how teachers' conceptions about ability can be tied to their ideas about the subject they teach. In her study, the team of math teachers who operated under the assumption that their subject consists of a sequential body of knowledge and procedures explained their students' success or struggles in terms of ability and

motivation. Meanwhile, the team that held a nonsequential view of math to which each student brings different strengths and weaknesses looked for explanations that involved instruction and curriculum. These differences had implications for the types of instructional practices teachers felt were appropriate for their students. The team that believed math was procedural and sequential viewed students' previous poor math performance as an indication that students were unable or unwilling to take on tasks that were cognitively challenging. This case illustrates how teachers' beliefs about student ability and motivation and academic subject can inform one another and, in turn, can inform instructional decision-making.

Similarly, in their study of fourth to sixth grade teachers, Stipek, Givvin, Salmon, and MacGyvers (2001) found that teachers tended to hold belief systems with sets of beliefs about math, students, and learning, and these belief systems were associated with particular teaching practices. Teachers who viewed math as a set of procedures also believed that students should focus on performing with accuracy and that mathematical ability is a fixed trait. These teachers tended to exert more control over their students' math studies. Teachers who afforded their students more autonomy tended to be those who emphasized mathematical concepts over procedures. These same teachers also believed mathematic ability is malleable and emphasized student understanding rather than correct answers.

In their study of secondary mathematics teacher workgroups, Horn and Kane (2015) documented the difference in how different math teacher groups framed the task of planning depending on the beliefs they held about math. Teacher groups that believed planning involved pacing their classes to cover a body of material made different types of

instructional decisions than those who framed the task of planning as figuring out how to build upon their students' current understanding. If a teacher's job is to pace the year to ensure coverage of sequential topics, building up to a complete body of mathematical knowledge, then task selection, instructional methods, and assessment are all likely to be shaped by this frame. On the other hand, students may experience a very different type of instruction and assessment from teachers who believe their job is to help students construct an understanding of mathematics by exploring a network of ideas.

Beliefs about teaching. As illustrated by Horn (2007) and others (Coburn, 2001; Spillane, 1999), teachers' beliefs about their work have consequences for the instructional decisions they make. Teachers' instructional decisions are also highly personal, emotional, political, and moral in nature (Kelchtermans, 2009). The decisions teachers make are influenced not only by the beliefs they hold about the nature of their subject, but also beliefs about their role in teaching it (Horn & Kane, 2015).

One aspect of teachers' beliefs that has been widely studied since the 1970s is beliefs about their efficacy (Kelchtermans, 2009; Wheatley, 2002). Teachers looking at student assessment data sometimes attribute poor student performance to factors outside of teachers' control (Oláh et al., 2010). In deciding whether to use a particular technique in the classroom, teachers' decisions are shaped by whether or not they feel they can implement it successfully (Czerniak & Lumpe, 1996; Fives & Buehl, 2012). Teachers' efficacy beliefs have been tied to numerous positive outcomes, such as openness to student-centered instructional reform (Czerniak & Lumpe, 1996).

Yet Wheatley (2002) explained how efficacy beliefs can sometimes hinder teacher learning and change. If teachers doubt their ability to teach certain subjects, use

certain types of instructional techniques, or teach certain students, teachers may dismiss reform efforts too easily. Likewise, if teachers feel overconfident in their current practices, they are unlikely to seek new methods to improve. On the other hand, teachers who doubt their efficacy but believe it is possible to do better are motivated to learn and change. Wheatley argued that, in order to improve, teachers must allow themselves to doubt their current efficacy. This may be problematic for teachers who believe their role is to be an expert imparting knowledge to students, but may come more easily to teachers whose professional identities leave more room for doubt.

Deliberation for Changes to Beliefs and Practice

Opportunities to deliberate with colleagues can be extremely influential on the beliefs teachers hold. Time to work in formal communities that support open discussion can be instrumental in changing how teachers view their contexts (Coburn & Turner, 2011), as information is filtered through communities with emphasis placed on some ideas over others (Spillane, 1999). Conflicting beliefs are validated or ignored depending on the range of experience and the dynamics of group members (Coburn, 2001; Fives & Buehl, 2012; Spillane et al., 2002). Therefore, teachers can come to very different understandings of their contexts depending on who they interact with or the extent to which they work in isolation.

Because the kind of deliberation teachers experience depends heavily on who participates in discussions, researchers have noted that the level of instructional expertise in a group can be a limiting factor in the depth of deliberation that occurs (Horn & Kane, 2015). Without sufficient expertise in a group, teachers may reinforce existing ideas and methods rather than moving towards improvement (Marsh, Bertrand, & Huguet, 2015).

This is one reason that coaches are often used to help facilitate teachers' collaboration (Gibbons & Cobb, 2016; Gibbons, Kazemi, & Lewis, 2017; Marsh et al., 2015).

The content of teachers' discussions can also make a difference to the depth of deliberation that teachers experience. Teachers' conversations around a shared goal in a process of inquiry can support changes to beliefs and practice (Gallimore et al., 2009). Another common approach to deepen educators' collaborations is with the use of student data to guide decisions for practice. Under some circumstances, collaborative data use can support fruitful discussion about student understanding (Cosner, 2011). Such approaches, however, require group trust and norms that allow teachers to engage in meaningful rather than superficial discussion (Datnow & Hubbard, 2015a, 2015b; Horn & Little, 2010). If teachers lack trust or if a school culture has strong norms of privacy that prevent teachers from sharing details of their practice, discussion is unlikely to involve true deliberation of teachers' beliefs and practices (Coburn & Turner, 2011; Little, 1982).

Given that the beliefs teachers use to guide their conversation have implications for the instructional decisions they make and that these beliefs are negotiated when teachers deliberate with one another, understanding the ways in which educators lobby for a group orientation to particular beliefs over others can provide key insight into the success of instructional reform efforts.

Method

This comparative case study employs qualitative observation and interview techniques to examine teachers' collaborative negotiation of beliefs. Observations provide insight into how teachers voice and deliberation their beliefs in real time, while

interviews provide additional context for their meetings and the meaning they make about reforms.

Sample

The sample from this study consists of middle school math teachers in two schools in a large urban school district in the US. Pseudonyms for these schools are Silverleaf Middle School and Waterford Middle School. Data for this study were drawn from the first year of a larger four-year project focused on continuous improvement in mathematics through coaching, pedagogical supports, and teachers' use of student data. All of the schools in the wider study were chosen because of their consistently low performance on state-mandated math assessments. The two schools for this study were selected because they have established routines of formal collaboration time through which reforms are implemented. At both schools, Hispanic/Latino students made up the bulk of the student population (between 65-80%) according to the School Accountability Report Card (2017), with the next largest group being White students at Silverleaf and Indochinese students at Waterford. The English Learner population at Waterford was around 40% (closer to 20% at Silverleaf). According to the National Center for Educational Statistics (2016), 75% of Silverleaf students qualify for free and reduced lunch, while that figure is 97% for Waterford.

The math departments at both schools were undergoing multiple reform efforts aimed at improving math instruction, some of which had been in place for several years at the start of the present study. In addition to the data use from which the data for this study are drawn, each school was also engaged in reform initiatives mandated from the district (though Silverleaf to a greater extent than Waterford) as well as school-specific

reform efforts. Some teachers were also participating in additional external reform efforts. Although each reform effort had a different focus, they shared several common goals:

- move away from a focus on math procedures to a focus on conceptual understanding
- attend to discourse as a way for all students to engage with math at a high level
- attend to students' mathematical reasoning to allow all students to access the curriculum by building on what students know (rather than focusing on building students' basic skills that are below grade level)
- work collaboratively to achieve these goals

The main goal of all reforms was to improve instruction so that all students could successfully engage with cognitively rigorous mathematical content.

The math departments at the schools were comparable in size, with 22 general education teachers between them and six special education teachers assigned to co-teach math as part of their day. These co-teachers varied in the degree to which they attended meetings with the math department and with their math grade level teams. All of the teachers had at least eight years of teaching experience (though not necessarily in math or at the same school) except for three newer teachers who had less than four years experience each. Each school had an assistant principal assigned to oversee the math department, plan meeting agendas to some degree, and regularly attend math meetings.

At Silverleaf, math teachers met twice a month, though half of those meetings were devoted to working on completing requirements for their participation in another program and, thus, were not observed for the present study. For the remaining meetings,

teachers most often met with their grade-level math teams, but occasionally came together to meet as an entire department. For teachers who taught multiple grade levels, the assistant principal assigned them to meet with a single grade level team throughout the year. At Waterford, the department met all together six times during the year, with grade-level teams meeting approximately two times per month.

For the purposes of confidentiality, the grade-level math teams for each school have been given pseudonyms for this study. The Silverleaf teams are Acacia, Sequoia, and Orchard. The Waterford teams are Ocean, Lake, and River. The teams' interactional styles and team member beliefs are described throughout the findings section.

Data Collection

Data collection took place over the course of the 2015-16 school year and involved observation of teachers' formal collaboration time and one-on-one semi-structured interviews with each teacher.

Observations. Formal meetings for both grade-level groups and the whole math department at each school were observed and recorded in detailed field notes. Grade-level meetings typically involved 2-6 math teachers all teaching the same grade and, in some cases, a school administrator. Department meetings were attended by math teachers of all grade levels at a school as well as at least one school administrator. Because these schools were undergoing multiple reforms, meetings were often attended by at least one reform coach. At Silverleaf, three different coaches attended at least one meeting each. At Waterford, five different coaches were in attendance at a minimum of one meeting each. At each school, there were some instances when multiple coaches attended the same meeting. A total of 17 meetings were observed for Silverleaf, and 15

for Waterford. Each meeting lasted from 40-120 minutes, with the exception of one, which broke up after 10 minutes. Field notes include information about who attended, where they sat, who addressed whom in conversation, what teachers said, the formal meeting agenda, and what topics were actually covered in the meeting. Since no audio or video recording was used, a complete verbatim transcript of each meeting was not available. However, detailed field notes provide sufficient detail of relevant parts of the meetings to be used for the purposes of this study.

Side conversations frequently occurred informally between a few teachers about particular students' recent behavior or personal circumstances. Although these conversations happened during formal collaboration times and everyone could hear them, it was clear that they were not intended for general discussion, and even coaches and administrators generally did not engage in these conversations unless they were personally addressed. Due to their highly personal nature for specific students, belief statements made during these conversations were noted and described in field notes, but were not recorded in detail or included in the analysis unless they were taken up for general discussion.

Interviews. All math general and special education teachers at both schools were interviewed (N=27) towards the end of the school year, with the exception of one general education teacher at Silverleaf who declined to be interviewed. These semi-structured interviews took place in teachers' classrooms after school or during teachers' student-free work periods and lasted approximately 45 minutes each. Interviews were audio recorded and professionally transcribed.

Although certain questions were designed to elicit particular information from teachers, the nature of the semi-structured interviews provided teachers with multiple opportunities to discuss relevant topics. Several questions elicited particularly relevant data for this study. Teachers were asked, "Can you think of any examples of how conversations with a colleague, formally or informally, have led you to think differently about what you do in the classroom?" This question yielded data on teachers' experiences of learning from one another and altering their beliefs. The extent to which teachers felt they could trust one another was measured by questions such as "How do you feel about sharing your data about your students in meetings?" and "When you are not in formal meetings, do you find yourself discussing your teaching practice with colleagues? What kinds of things do you discuss? Who do you usually have these conversations with?" Teachers were also asked to describe their methods of planning and conducting lessons for the diverse learners in their classrooms. This provided data on teachers' beliefs as well as their collaboration with one another.

Data Analysis

Observation and interview data were coded and analyzed in stages using a variety of tools, including Excel and the qualitative data analysis software MAXQDA. First, data were coded for *belief statements.* These are statements that overtly expressed teachers' beliefs about the feasibility or appropriateness of applying the reforms' goals in their setting. These statements were then coded along the following two dimensions. Statements were coded as *positive* if they supported the idea that the reforms goals were feasible and appropriate in their school context. Statements were coded as *negative* if they supported the idea that the reform goals were not feasible or appropriate in their

context. Although there are certainly cases in which teachers may resist the goals of reforms because they are not in the best interest of their students (Gitlin & Margonis, 1995), these reform goals (noted above) are well supported by research. The codes were applied only to teachers' beliefs about the feasibility of the reforms. Next, these statements were coded for the explanation behind the positive or negative assessment. All explanations were then collapsed into three broad categories: *students, teaching,* and *math.* Table 1 shows definitions and examples of each of these codes.

Table 1. Categories of Belief Statements

Beliefs Explanation	Beliefs About the Feasibility of a Reform	
	Positive	Negative
Students	Students, as they are currently, could engage with cognitively rigorous mathematical content under this reform. Example: "I did a day of 'what do you know' before we started geometry and they filled two boards of what they know about geometry."	Students have some kind of deficit that is an obstacle to students engaging in cognitively rigorous mathematical content under this reform. Example: "For boys at this age, they just look and see how much work it is. If it's too much, they won't even get into it."
Teaching	It is possible to teach in a way that allows students to successfully engage with cognitively rigorous mathematical content under this reform. Example: "I'd do these open ended questions first to see what they can do before I try the book version that tells them how to set up the equation."	The nature of teaching prevents implementing this reform in a way that allows students to successfully engage with cognitively rigorous mathematical content. Example: "But they've been on it for so many days and we're still on [the introductory section]"
Math	The nature of mathematics makes it possible for students to successfully engage with cognitively rigorous mathematical content under this reform. Example: "Well they didn't have ideas connected. They have a lot though and you only had to take it just a little bit to fill in to the next level."	This reform is not compatible with the way students learn mathematics. Example: "[The reason students can't understand a concept is because] they don't know their times tables."

A minimal (<1%) number of expressions of beliefs could not be categorized as either positive or negative (e.g. "I have to find ways to make kids care about [learning]

goals. I have to get them involved in the goal-setting"), and they were excluded in the analysis. A small number of statements were coded as positive or negative with one or more explanation. For example, "Instead of showing them, ask them. Release that responsibility back to the students" was coded as positive/teaching/students since the speaker was advocating for a change in instructional practice that was rooted in a belief that students were capable of rigorous engagement with the material.

Next, statements that teachers made as a way to challenge another person's expressed belief were coded as a *challenge* along with any other appropriate codes. If a belief statement was challenged and the discussion took multiple turns, this was counted as *deliberation* of the belief. Challenges were deemed *successful* either when educators agreed to the positive view of the belief, or when the negative side of the deliberation was dropped.

A priori codes from the literature were applied to field notes and interview transcripts. These included the role of *leadership*, discussion of *instructional strategies,* and evidence of *trust* among educators. Two additional codes from the wider study from which this sample is drawn were also applied in subsequent rounds of coding as their relevance became apparent. These were student *placement/tracking* and use of *data* (along with subcodes for various types of data use). Other emergent codes that were applied were discussion of *student thinking*, and instances that served to break down or prevent *norms of privacy* to inspire teachers to collaborate more.

Types of belief statements, challenges, deliberations, and challenge outcomes were analyzed across other the codes as well as by the individuals, teams, and schools

involved in order to identify patterns in the expression and deliberation of beliefs. These patterns are explained in detail in the following section.

Findings

Although formal collaboration time at both schools included groups of teachers who shared similar students, responsibilities, resources, and teaching contexts, the expression and deliberation of beliefs varied considerably by school, grouping, and discussion topic. This section begins with an overview of the frequency and types of belief statements and deliberation that were observed at each school. The discussion topics that elicited belief statements are then examined. Finally, findings about the central the role of trust and privacy in how teachers deliberate are discussed.

Expression and Deliberation of Beliefs

Expression and deliberation of beliefs varied across school sites. A total of 291 statements overtly mentioning educators' beliefs about teaching, students, or math were recorded in field notes for 32 meetings across both school sites. The frequency of these statements and the resulting challenges and deliberation of them varied by school site and by teacher team. Table 2 gives an overview of the statements, challenges, and deliberations across both schools. Included in this table are statements made by teachers, coaches, and school administrators during formal math meetings.

Table 2. Overview of Belief Statements

Observation	Silverleaf	Waterford
Total meetings observed	17	15
Meetings in which a belief statement was made	12 (71%)	12 (80%)
Positive belief statements	81 (73%)	100 (56%)
Negative belief statements	30 (27%)	80 (44%)
Total conversations involving negative belief statements	16	24
Conversations involving unchallenged negative belief statement(s)	8	7
Conversations in which negative belief statement(s) were met with a single challenge	2	7
Conversations in which negative belief statement(s) resulted in deliberation*	6	10

*Deliberation here defined as a challenge to a negative statement that resulted in multi-turn discussion

Belief statements were more frequently expressed, challenged, and deliberated at Waterford. One hundred and eighty (62%) of the overt belief statements observed in this study were spoken at Waterford. Most of the meetings observed at Waterford (80%) involved some belief statements. These statements were often addressed with challenges and deliberation. Looking at discrete conversations within meetings when discussion took place over multiple turns before moving on to a new topic, 71% of conversations involving negative beliefs included single turn challenges or, more commonly, lengthier deliberation of those beliefs. Although these beliefs were expressed frequently at Waterford, they were not equally distributed across grade level teams or individuals.

When teachers met solely with their grade level teams without outside coaches or administrators, two of the teams avoided overt belief statements entirely or only made

them only in side conversations. The Lake team was the exception to this, but their conversations generally included only negative statements such as "[students] don't care," without challenges or deliberation.

When Waterford teachers did make overt belief statements, some teachers did so much more frequently than others, with one teacher making no belief statements at all. Figure 2 displays the frequency and types of statements made by individual educators. The types of belief statements made by educators also varied. Most of the 180 overt belief statements at Waterford were positive (56%), and these were made by a variety of educators at the site. Yet most of the negative statements (67%) were made by only three teachers. The two teachers who made the most negative belief statements were both part of the Lake team, although their belief statements were not restricted to times when they met alone as a grade level. Figure 2 shows the distribution of positive and negative statements made by educators at each school.

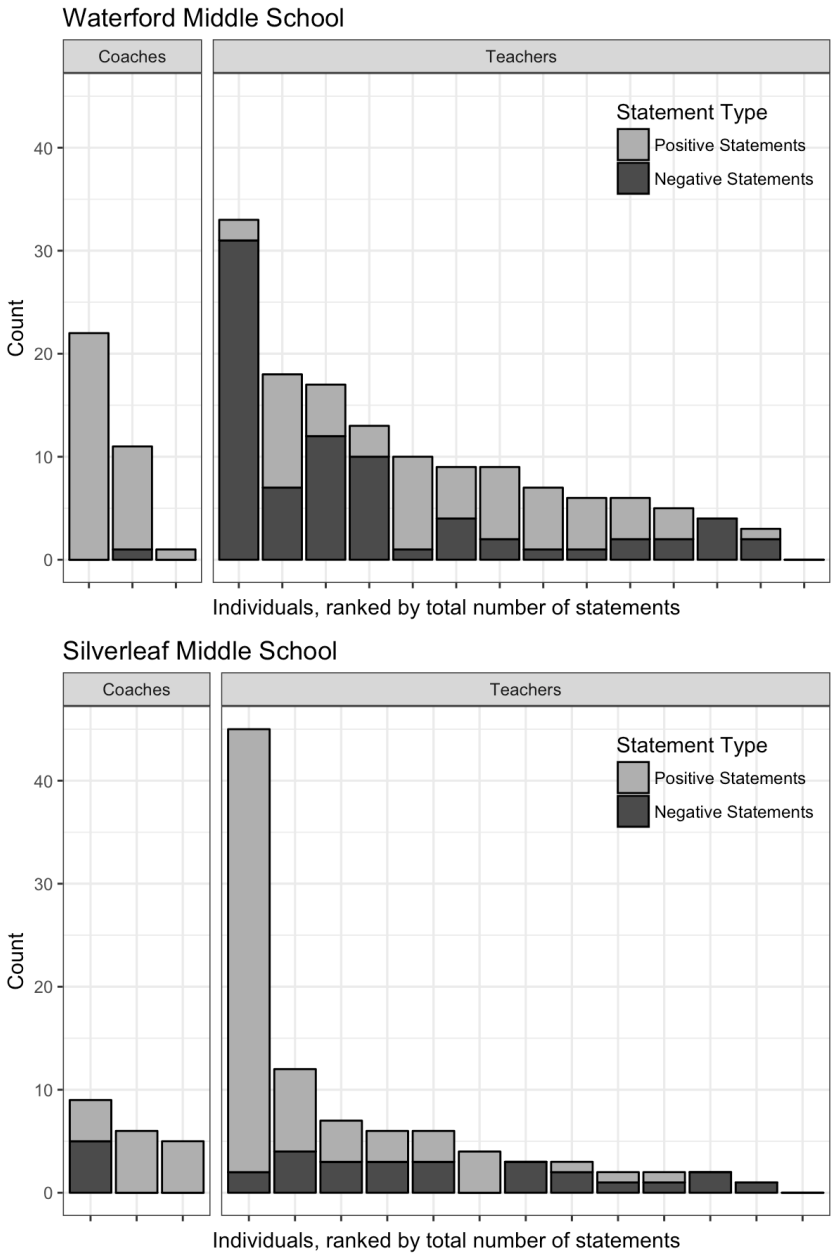

Figure 2. Distributions of positive and negative belief statements made by individual coaches and teachers.[1]

[1] In Figure 2, one school administrator was listed as a teacher for confidentiality purposes.

Silverleaf teachers were less likely to express and deliberate beliefs. Only 32% of the belief statements in this study were observed at Silverleaf. Further, 29% of formal Silverleaf meetings did not include a single overt statement of beliefs. In discrete conversations that included negative belief statements, these negative statements went unchallenged 50% of the time. There are several possible explanations for why educators would let negative beliefs pass unchallenged. It is possible that other educators did not hear the negative statement, that the group was running short on time and needed to move on, that the statements did not align with the agenda, that teachers wanted to keep the peace and avoid arguments, that negative statements were ignored for strategic reasons or addressed indirectly, or that there was a lack of diversity of opinion or expertise in the room. Only 38% of conversations that included negative statements involved multi-turn deliberation of conflicting beliefs.

Like at Waterford, positive belief statements were more common at Silverleaf than negative statements. Of the 111 belief statements at Silverleaf, 81 (73%) were positive and 30 (28%) were negative. Also similar to Waterford, some teachers made many more belief statements than others. Yet at Silverleaf, negative belief statements were spread among educators and positive statements were concentrated among a few individuals and teams. One Sequoia teacher made 53% of the positive belief statements observed at the school. All together, Sequoia teachers accounted for 73% of positive Silverleaf statements, with coaches accounting for another 19%. Note that Silverleaf teachers did not express more negative beliefs than Waterford teachers, they were simply less likely to express beliefs.

Like at Waterford, individual grade level teams at Silverleaf generally avoided making belief statements, with the exception of Sequoia. However, unlike the Lake team at Waterford where negative beliefs went unchallenged, conversations at Sequoia meetings always involved rich deliberation of conflicting beliefs. In the following example, Sequoia teachers deliberated how much time should be spent reviewing concepts before asking students to engage with grade-level material in a new unit. The first teacher was advocating for spending little or no time on concepts that were not at grade level, while the second wanted a long review period.

Sequoia Teacher 1:	Well, I did a day of "what do you know" before we started geometry and they filled two boards of what they know about geometry.
Sequoia Teacher 2:	My kids knew nothing when I surveyed them.
Sequoia Teacher 1:	Well they didn't have ideas connected. They have a lot though, and you only had to take it just a little bit to fill in to the next level.

The meeting agenda for the day had involved filling out a school climate survey. This could have been accomplished without discussion about math instruction or teachers' beliefs about math, their students, or their instruction. The Sequoia team operated from the same agenda (set by the school administrators) as did the other Silverleaf teams, yet the Sequoia team was the only one to consistently engage in this type of deliberation. Although this was typical of the Sequoia team, it was rare among other teams at both schools.

Common in both schools was the predominance of two types of beliefs: positive/teaching and negative/student. These two orientation/explanation combinations were more common than any other pairings. Half of all belief statements made across both schools involved the positive/teaching orientation. Negative/student was the next

most prominent, found in 26% of belief statements. At Waterford, 46% of belief statements involved positive/teaching orientations, and 33% involved negative/student. At Silverleaf, 57% of belief statements involved positive/teaching orientations, and 15% involved negative/student. Almost every instance of challenging a negative belief of any kind was done with a positive/teaching statement.

Conversation Topics and Their Relationship to Belief Statements

Conversations were more likely to involve the expression or deliberation of beliefs when they centered around one of three topics: student data, student tracking, and math-focused instructional strategies and student thinking. All expressions of belief could be categorized into these three topics, although much of teachers' formal collaboration time was spent discussing other topics such as curriculum pacing or other scheduling issues. Although these topics elicited statements of beliefs, they did not guarantee challenges or deliberation. Instead, deliberation seemed to depend largely on who was in the room or dominating the discussion.

1. Discussions about placing students in existing tracked math classes involved frequent negative/student belief statements, but deliberation was sporadic. There were five instances across the two schools that involved discussion of using student test scores to place or track students in math classes. Each involved some degree of negative/student beliefs, but most of these beliefs went unchallenged. In the two instances where challenges were made, they were brief and unsuccessful.

The most deliberation on the topic took place at Silverleaf, where no one questioned the belief that certain students were not capable of the rigorous instruction of

the advanced class until the third and final observed conversation, which involved Orchard teachers and a school administrator:

> Orchard Teacher 1: I have some [students] in the accelerated class this year who should not be in there.
> Orchard Teacher 2: Due do a lack of effort or cognitive ability?
> Orchard Teacher 1: Cognitive ability.
> School Administrator: Now that's not fixed, remember.
> Orchard Teacher 1: For this one it is.
> Orchard Teacher 3: I have some that need to go up.
> Orchard Teacher 2: Me too. I've always had an issue with tracking because if you have late bloomers who aren't identified early enough who then can't move up just because they're missing the curriculum.

Although the school administrator made a point of challenging the negative/student belief that cognitive ability is fixed, the district curriculum involves regular and accelerated tracks in math. It is not surprising, then, that this challenge was unsuccessful. The beliefs of the first teacher who wanted to move students to the accelerated track were not explained, but the second justified this move based on some students being "late bloomers," which only partially challenged the negative/student belief expressed by the first teacher.

A more typical example comes from a Waterford teacher's account of moving a large portion of a class to the accelerated track:

> They're having a great time. But I'm left with the ones who are not advanced. And there is no one to work with them to help them. They don't care. They don't do their homework […]. They go on a trip for 3 hours to Mexico and they don't do their homework in the car. "I'll take the zero," they say.

These negative/student beliefs were not challenged and the conversation moved on to other topics. Although conversations about how to place students in the existing

tracks were likely to elicit statements about beliefs, these statements were predominantly negative and were unlikely to be deliberated.

2. Discussing student data involved frequent expressions of beliefs, but different forms of data were associated with different types of belief statements and deliberations. The most common type of data discussed was standardized assessment data including state mandated yearly assessments, district-created interim assessments, and various readiness exams issued by the district and reform efforts. The types of statements expressed about standardized data depended largely on whether teachers were discussing raw scores or answers to particular questions, whether the test was in the past or upcoming, and whether the data were used for formative or accountability purposes. School administrators played a central role in framing conversations about standardized data.

Belief statements about other types of student data such as student classwork or student answers to teacher-created assessments were more varied. These types of data were frequently evoked to challenge negative belief statements. School administrators rarely required teachers to discuss these types of data.

Standardized assessment data. Types of standardized assessment data discussed during formal meetings included state-mandated test scores, district-mandated interim assessment scores, and scores from placement and readiness exams. In some cases, these scores were reported across an entire grade level or classroom as the number of students who fell into different proficiency levels. At other times, they were reported as raw scores for individual students, which were also categorized into proficiency levels. In the

case of some readiness tests and district interim assessments, teachers could view overall or student-specific answers to individual test questions.

Silverleaf administrators required teachers to analyze these data in grade-level teams using a data protocol. Waterford administrators required teachers to analyze some kind of data in grade-level teams and present it to the department as a whole. Although they did not specify that teachers should use standardized assessment data, teachers usually did so.

Administrators also frequently referred to past and upcoming standardized assessments with an accountability framework, emphasizing raising students' scores for accountability purposes. Twelve of the 17 Silverleaf meetings contained agenda items or included comments from school administrators related to the accountability aspects of standardized assessments. At Waterford, six of the 15 observed meetings included comments by school administrators such as "ultimately, we are still being looked at by our numbers" that emphasized the accountability aspects of standardized testing. At grade-level meetings when the administrator was not present, an additional three Waterford meetings contained statements by teachers such as "I don't know how to prepare my students for [the exam]," expressing anxiety about students' performance on upcoming standardized tests. Only one teacher, from the Lake team, discussed already available standardized data from an accountability framework in the same way administrators did, and this teacher is the same one who accounted for 39% of the negative belief statements made at Waterford. There were no observed incidents of coaches originating any discussion emphasizing accountability frameworks at either school.

At both schools, when standardized test data of any type were discussed with an emphasis on accountability, negative statements predominated. This was especially true of past rather than upcoming standardized data. Whereas upcoming standardized assessments elicited many statements of anxiety and some negative/teaching statements, discussion about the accountability aspect of already available student results universally elicited negative belief statements, which were either unchallenged or difficult to challenge.

At Waterford, when low standardized test scores were discussed during meetings, educators always immediately attributed students' poor performance to deficits of the students themselves. They attributed these scores to lack of student motivation and to the challenges students face at home and in their communities. These negative/student explanations were not challenged. The result was lengthy discussions about what schools could do to help students care more about school and testing. The following excerpt from field notes from a department meeting describes discussion about students' low state test scores:

> There was brief discussion about whether or not the problem was the parents. An Ocean teacher said that the students are self-destructive. They don't see how math is relevant. The teachers discussed using prizes to motivate students. A River teacher argued that they need similar motivators for parents, "especially our parents around here."

This exchange demonstrates the tendency for teachers to focus on external causes of low test scores when discussing accountability assessments. At one point, the administrator attempted to steer the conversation towards what the school could do to address some of the concerns the teachers were raising about students and their families.

Similarly, when confronted with low standardized test scores, Silverleaf educators also focused initially on external causes beyond their control. Unlike the Waterford teachers in the example above, however, they had a copy of the district's interim assessment to look at while they discussed students' performance. Whereas the Waterford teachers attributed the poor performance to student deficits, Silverleaf teachers initially attributed results the format of the test. These explanations went largely unchallenged, with any brief challenges swiftly dismissed. This resulted, eventually, in a discussion about instructional strategies. However, rather than focus on ways to improve students' understanding of the subject matter, which would have been in line with the goals of the reforms, educators discussed ways to alter their teaching to include more instruction on the logistics of test-taking. In the following example, several Orchard teachers, a school administrator, and a coach discussed their student's poor performance on district-mandated interim assessments and whether or not students would do poorly on the next interim:

Orchard Teacher 1:	The problem isn't that they can't do it. It's the test. Not knowing how to click multiple answers.
Orchard Teacher 2:	No, even this right here [pointing to an assessment question]. They forget how to do it.
Orchard Teacher 1:	They get one out of two right. If you switched it to multiple choice, I guarantee the percentage would go up.
School Administrator:	Let's address that in the common assessment.
Ocean Teacher 3:	We have made tests like that in [test-making software] so they could practice. We also did the [state test] practice last year as warm ups.
…	
Coach:	There could be an exit slip without the multiple choice.
Ocean Teacher 3:	Or leave them multiple choice and have them justify their answers.

Coach: Absolutely.

One teacher, early on, challenged the belief that the problem was the test itself by drawing attention to a math-related error in student thinking. This could have led to a discussion about different types of instructional changes more in line with the reform goals. This challenge was unsuccessful, however. Teachers then began to seek instructional solutions that moved away from the reform goals of engaging students in rigorous cognitive engagement around math and instead focused on test-taking practice. This was typical of conversations at Silverleaf that involved an accountability focus of student data.

This particular exchange, however, is notable in that a coach subtly shifted the direction of the conversation. As teachers worked toward solutions that moved away from the reform goals, a coach attempted to shift the predominant negative/teaching orientation by suggesting solutions that involved the type of teaching that was in line with reform goals. Not only was her challenge successful, but another teacher also started looking for teaching solutions in the same vein. Although the attribution for the poor performance was never deliberated, the perception that teachers had to alter their instruction away from the reform goals was shifted with the help of the coach, and a positive/teaching orientation prevailed in the end.

One team stood out as discussing standardized assessment data differently. The Sequoia team differed from others in that, when presented with access to assessment questions and a breakdown of how many students chose different answers, Sequoia teachers expressed and deliberated a wide range of belief statements. Deliberation was

more common among Sequoia teachers than any other team in large part because they had a teacher who steered the conversation in productive directions.

Other types of student data. Non-standardized data evoked more diverse belief statements, and were often used to challenge negative belief statements. When teachers purposely discussed other types of student data (such as teacher-created formative and summative assessments and observation of student discussions), they expressed a wide range of belief statements. Their likelihood of challenging or deliberating belief statements, however, was not related to whether or not they were engaged in a discussion around student data. These types of student data were, however, commonly evoked as evidence by some teachers and coaches to challenge negative belief statements in an attempt to establish a positive/student or positive/teaching narrative.

This example came from a conversation between three Lake teachers and a coach. The Lake teachers had started the meeting before the arrival of the coach with a strong negative/student and negative/teaching orientation. When the coach arrived, she attempted to shift that orientation by asking the teachers to show her some examples of student work on a recent class assessment.

Coach:	A good way to do it is to have students look at errors. Show them three and ask which one is correct. Something where they can compare. What would make the most sense in the comparison of setting it up? I have a feeling the computation won't be a problem if they can set it up.
Lake Teacher 3:	It's still a problem.

In this case, the coach's use of student data to challenge negative beliefs with positive/teaching statements was unsuccessful, and she was never able to shift the

negative narrative of the meeting. However, appealing to this type of student data was a common tactic used by both coaches and teachers attempting to challenge negative beliefs.

3. When discussions centered on teachers' instructional practices and student thinking around math, overt statements about beliefs were expressed frequently, sometimes resulting in challenges and lengthy deliberations. It was rare for conversations that included discussion about math-focused instructional practices to pass without any overt belief statements. However, whether these included challenges and deliberation depended on who was present at or dominating the meeting. When educators challenged negative belief statements, challenges that included a combined focus on instructional strategies and student thinking around math were the most successful.

At Waterford, 73% of observed meetings included some discussion about instructional practices. Almost all of these discussions included belief statements, and 90% included deliberation. Moreover, all teams were equally likely to voice and deliberate belief statements at Waterford, though this most often took place at department-wide rather than grade-level meetings.

Silverleaf meetings included discussion about instructional practices only 47% of the time, and 75% of these either took place at Sequoia team meetings or were initiated by Sequoia teachers at department meetings. All of Sequoia's discussions about instructional practices included belief statements and deliberation. The discussions about instructional practices that did not include Sequoia teachers did include belief statements, but they were not challenged or deliberated. The following example is taken from a

discussion between two Acacia teachers and a coach. During the meeting, no belief statements were made until this sole instructional strategy was mentioned:

Acacia Teacher:	That's why first thing I have them do is write down the squares and square roots.
Coach:	Yeah. Because for the lower kids, they're like "what just happened?"

As soon as the instructional strategy was described, the coach responded with a negative/student belief that attributed the stable quality *low* to a group of students. Neither teacher challenged this and the discussion moved on. Although discussions about instructional practices tended to elicit belief statements, whether or not these statements were challenged or deliberated depended on the team.

Challenges to negative statements were overwhelmingly made with positive/teaching statements. Yet some positive/teaching challenges were more successful than others. Challenges that were more likely to be accepted with less counter-argument were rooted in student thinking around math concepts and accompanied by instructional strategies. These statements involved an explanation of how students might be reasoning about a particular math topic and specific steps a teacher could take to address students' misconceptions and build their understanding.

In the following exchange, three Sequoia teachers, a school administrator, and three coaches examined the results of a formative assessment toward the beginning of the year. They had just looked closely at three assessment items on which the students had performed poorly.

Sequoia Teacher 3:	For boys at this age, they just look and see how much work it is. If it's too much, they won't even get into it. You've got to motivate too.
School Administrator:	Can we look at their strengths too please?

[They looked at another item.]

Sequoia Teacher 1: This is what they did. They just knew how to manipulate the mixed number into an improper. They don't know that those two wholes are 14/7. The next most popular answer was 6/7 where they just multiplied the wrong thing. I'm telling you, drawing eliminates these problems.

Sequoia Teacher 2: But it doesn't help with fluency. Are they going to draw out every one?

Sequoia Teacher 1: No, just at the beginning. We draw out every one and then they develop the rules.

Here, the administrator attempted to steer the conversation away from a negative/student discussion and back to a focus on the student data. The first Sequoia teacher put forth an explanation that included student thinking and a corresponding instructional remedy. When the second Sequoia teacher argued that the solution was not a feasible way to teach, the first explained why it was. From that point on, the other educators were interested in pressing the first Sequoia teacher for more information about this reform-aligned type of teaching.

When challenges to negative statements were not rooted in subject-specific student thinking and instruction, they were less likely to be successful. In the following exchange, two Ocean teachers attempted to challenge another's negative belief statements at a department meeting.

Ocean Teacher 1: My [students] want nothing more than to talk or come up to the front of the room. Maybe it's a grade level thing.

Ocean Teacher 2: No, it's your room. What did you do to them? I love it!

Ocean Teacher 3: It's your [English Learner] kids. They're super motivated.

Ocean Teacher 1: I try to do a lot of high fives and stuff and make it fun.

Ocean Teacher 2: I sometimes do all boys and all girls. The boys just

bloom. They get so much more confidence. Sometimes they go back to their normal role when it's combined again, but not always.

Ocean Teacher 3: We have only 13 boys and 21 girls so I can't really do that.

In this exchange, the third Ocean teacher first attributed the first's success to a stable characteristic of her students (English Learners) rather than to her teaching. When the first two Ocean teachers offered suggestions of teaching strategies, the third Ocean teacher dismissed each as not feasible in her setting. None of the suggestions was concretely rooted in student mathematical thinking or math-specific instruction. This exchange was typical of these types of challenges, which were frequently unsuccessful.

The Role of Trust and Privacy

Trust appears to be fundamental to the expression and deliberation of beliefs. In groups whose teachers described in interviews low levels of trust, such as the Orchard and Acacia teams at Silverleaf, beliefs were rarely expressed or deliberated in formal meetings. Waterford teachers, on the other hand, reported some level of trust, which was reflected in their frequent expression and deliberation of beliefs. In groups where trust was the highest, such as the Sequoia team, the River team, and among a core group on the Ocean team, group members formed a united front when challenging negative beliefs in cross-grade level settings, speaking up frequently and backing each other up. Further, in these high-trust groupings, teachers engaged in a type of playful deliberation of beliefs that was not observed in other settings. The dynamics of this varied from team to team.

The Ocean team, for example, avoided overt discussions about beliefs when the entire team was present, but when three particular team members talked among themselves, playing with conflicting beliefs was the norm. This core trio reported using

similar teaching methods, collaborating with one another, and a high level of trust with one another. These three Ocean teachers frequently used negative belief statements to challenge even their own previously stated positive belief statements, or vice versa. In each case, the result was a strong positive stance. This was different from playing devil's advocate, however, because teachers did not privilege positive beliefs over negative beliefs until the end of the conversation. Instead, each belief statement appeared to be a reflection of a genuinely held belief that teachers then explored together.

In the following exchange, two of the teachers from the core Ocean trio discussed a lesson they had just observed another teacher teach. The students who had participated in the lesson had struggled with the material, and the teacher who had taught the lesson was not present for this conversation between the Ocean teachers.

Ocean Teacher 1:	Most were not engaging. Is it because they don't know the math? It's like someone is speaking Chinese to someone that doesn't know Chinese.
Ocean Teacher 2:	They could understand.
Ocean Teacher 1:	Yes. It could have been scaffolded.
Ocean Teacher 2:	[I'd say] "Let's all focus around one strategy."
Ocean Teacher 1:	If I see everyone is avoiding one question, I stop and have a group conversation around it

This teacher began by citing students' deficiencies as the reason for their struggles, but, with the help of the other teacher, challenged that belief with a teaching solution. When these teachers met in their trusted group, their conversations commonly unfolded like this, as a way for them to explore their own conflicting beliefs, jointly make sense of these perceived conflicts, and come to a shared understanding that invariably strengthened their positive stance. In department meetings, these three teachers presented a united positive/student and positive/teaching front.

Although the three Ocean teachers, in interviews, reported sharing similar teaching styles, this was not the case with Sequoia and River teachers who nonetheless reported high levels of trust and were observed engaging in the same kind of playful deliberation. Both the Ocean and River teams avoided this kind of deliberation at grade-level meetings when non-trusted individuals were present, and none of these playful explorations of conflicting beliefs occurred in the presence of school administrators. Ocean and River teachers generally only engaged in deliberation when the meeting topic demanded it, yet, along with Sequoia teachers who deliberated this way in all observed meetings, they all frequently voiced challenges to negative beliefs in cross-grade settings. Even River and Sequoia teachers who reported preferring more traditional styles of teaching voiced support for reform-oriented teaching methods in cross-grade settings as part of a united challenge to others' negative belief statements. It is possible that the playful deliberation in which they engaged with their trusted colleagues strengthened their confidence in the reform goals and gave them confidence to challenge negative beliefs in wider groupings.

One hallmark of the types of challenges these teachers mounted against negative beliefs both within their private conversations as well as in cross-grade meetings was the tendency to break down norms of privacy. These teachers and coaches frequently replayed conversations from their classroom to give insight into their instructional practices or discussed student data that helped illuminate their students' thinking. The four educators who were the most successful in challenging negative beliefs used these tactics extensively. The three educators who mounted the most unsuccessful challenges to negative belief statements employed these tactics only occasionally.

Discussion

Although these two schools had similar departmental and collaborative structures and were participating in several of the same reforms, they differed in the extent to which their formal collaboration times involved the deliberation of beliefs. The way teachers' collaborative time was structured and the topics they were required to discuss made a difference for the types of beliefs teachers did or did not express. Deliberation of these expressed beliefs occurred when groups felt some degree of trust, but resulting positive belief orientations depended on the discussion skills and teaching experiences of group members.

The results of this study reveal that deliberation occurs in settings where beliefs are voiced more frequently. The departments and grade level teams that habitually included statements about the feasibility of reforms also experienced deeper discussion about those beliefs and instructional practices. In groupings where teachers avoided voicing beliefs about the feasibility of reforms, discussion remained superficial and did not include the kind of deliberation that might engender changes to beliefs and practice. Superficial discussions were more common when meeting agendas involved tasks that could be accomplished without deliberation.

Several discussion topics were shown to elicit belief statements, but not all topics encouraged deliberation. Discussions about how to place students in existing tracked classes and conversations about standardized assessment data from an accountability framework were heavily entrenched in negative belief orientations that did not support reform-oriented deliberation. Even as schools were engaged in reforms that aimed to steer teachers' collaborations to other areas, these topics were frequently placed on

meeting agendas or raised in discussion. It is possible that discussions around these topics could foster deliberation if they were framed differently. However, even when administrators stated that teachers were to use standardized data to improve their practice rather than for accountability, an orientation towards accountability prompted teachers to discuss aspects of the data that were not related to instruction (student deficits, problems with the test, etc.). It is possible that the type of data that allow for easy quantifiable comparison between teachers elicits such strong defense mechanisms in teachers that deeper deliberation about instructional practices is unlikely. It is also possible that this effect was amplified by the fact that these schools were persistently low performing on these types of assessments and, as such, felt intense pressure and judgment from their district and wider community. Further, it is possible that educators did not see the point in deliberating these "permanent" features of the schools. Schools undergoing reforms surrounding these practices might provide teachers with environments more conducive to deliberation.

The schools in this study were, however, undergoing reforms aimed at increasing their use of student data for instructional purposes and improving instructional practices in math. Discussion surrounding math-specific instruction, student thinking around math, and non-standardized data elicited frequent statements about the feasibility of the reforms with both positive and negative orientations. These sometimes led to deeper deliberation depending on who was present for the discussion. In meetings where teachers were able to avoid discussing their math-focused teaching practice, student thinking about specific math ideas, or concrete examples of student work, they generally also avoided expressing and deliberating beliefs, regardless of who was present. This was the norm for most

Silverleaf meetings as the teachers could complete their agenda items with only a superficial discussion and no detailed discussion of daily math-related teaching practice. This was also the case for some Waterford groups when they had no agenda.

For educators to engage in successful deliberation that resulted in a positive orientation toward the reform goals, math needed to be the central focus of their conversations. Some individuals were adept at using these math-focused topics to challenge negative beliefs when they arose. Others habitually steered conversations towards these topics, fostering deliberation in the process. These meeting participants possessed deliberation expertise, sometimes transforming superficial conversations into opportunities for substantive change. They included some, but not all, school administrators, coaches, and teachers. School administrators fostered more deliberation when they structured collaboration time to include math-focused topics rather than simply standardized data or non-subject-specific teaching practices. Coaches and teachers who appealed to concrete examples of teaching specific math ideas to students steered conversations into deliberations about beliefs that were rooted in practice. When teachers voiced negative beliefs, these individuals challenged them with concrete examples of reform-oriented changes to practice that demonstrated the feasibility of reforms. When these discussion experts were able to create a strong positive orientation from the beginning of a conversation, negative beliefs that were voiced in the meeting were more effectively challenged.

One limiting factor in the success of deliberations in producing positive orientations towards reforms was whether or not groupings included a trusted member who had found success with reform practices. These individuals gained trust by

producing concrete examples of their success by bringing examples of their students' work as non-standardized data and sharing detailed retellings of conversations they had with their students about math. In groups where no members had found such success or where other teachers did not have opportunities to view their success through these processes, deliberation did not generally result in a strong positive orientation toward the reform goals.

Conclusion and Implications

In order for school reforms to bring about sustained substantive change, changes in teachers' instructional practice must be accompanied by changes in their beliefs. Deliberation with other educators is central to these change efforts. Yet not all formal collaboration time includes the kind of deliberation that can support changes to beliefs and practice.

School administrators are often in the position to influence teachers' formal collaboration times by providing some guidance as to the agenda. While too much structure may stifle deliberation, guiding teachers to work toward a goal relating to student thinking around a specific instructional topic can encourage teachers to bring details of their practice to their discussions and deliberate conflicting beliefs they hold. Asking teachers to collaborate around student work that demonstrates students' thought processes on a particular topic can be a way to bring about these conversations. Bringing such details from teachers' practice into formal collaboration times can help expose teachers to successes that their colleagues have found using instructional methods that are aligned with reforms. This might help groups move towards a collective belief that reforms are feasible.

One promising avenue for promoting positive orientations towards reform is providing teachers opportunities to discover the successes they are already having with some reform-related practices. When discussion centered on math, even those teachers who routinely voiced negative beliefs defended reform-oriented practices when they had successful personal experiences with them. They voiced challenges to negative beliefs when experiences from their classrooms provided them evidence that the reform goals were feasible. In settings where negative beliefs are particularly entrenched or when a lack of reform-oriented instructional expertise is available, a skilled discussion leader could assist teachers in identifying and building on these successful personal experiences.

Some coaches and teachers commonly elicited belief statements from their colleagues, prompted deliberation around beliefs, and/or successfully challenged negative belief statements. These individuals possessed a kind of deliberation expertise that deepened otherwise superficial discussions and often resulted in a collective orientation that supported the feasibility of reforms. Providing these individuals with greater opportunities to guide collaboration time may be a primary mechanism to promote the kind of deliberation that can lead to changes in beliefs and practices, and something that future research and reform efforts could explore.

Because its focus was on beliefs, this study does not speak to the actual instructional practices that teachers end up using in their classrooms after deliberation. There were instances observed in this study when teachers reported preferring instructional practices that were not aligned with the reform goals, and yet voiced challenges to negative beliefs in ways that supported reform practices. It would be useful to analyze such instances in light of teachers' actual or reported practice over a longer

period of time. It is possible that teachers in the early stages of changing their practice may hold somewhat conflicting beliefs, and that assisting in advocating for reforms is an important step toward changing their own practice.

This study provides many positive avenues for reformers to bring about change. Although teachers' beliefs about reform can often be conflicting, they can make sense of these in ways that promote positive orientations toward reform when the conditions are supportive. Individuals that possess the tools to promote fruitful deliberation are not uncommon, and school administrators have significant power to structure collaboration times in ways that utilize these individuals and focus discussion around fruitful topics. Further, voicing negative beliefs appears to be a primary way that teachers move toward a belief that reforms are feasible in their contexts. Reform is unlikely to be a simple process, and by voicing and deliberating conflicting beliefs, teachers can begin to imagine how new practices can bring about success and to find the successes they have already experienced. Therefore, negative beliefs are an important element of change. Creating an environment where the dominant orientation is positive provides a setting in which voicing these beliefs can be constructive rather than limiting.

Chapter 2 is currently being prepared for submission for publication of the material.

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Cultivating and Capitalizing on Teachers' Deliberation Expertise

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Abstract

Rich deliberation with colleagues has been shown to make a difference for how teachers collectively negotiate their beliefs and instructional decisions. Yet this type of deliberation is not guaranteed to take place during teachers' formal collaboration times. This study examines the role of deliberation expertise in supporting effective collaborative relationships between teachers to facilitate changes to their beliefs and practice. This type of expertise involves steering conversations with colleagues towards a collective belief that instructional reform is feasible in a given school setting. Using social network analysis and qualitative data analysis methods, the formal collaboration patterns and relationships between teachers in two middle school math departments were analyzed to identify the ways in which deliberation expertise is supported by and supports habits and structures of collaboration around instructional reform. The way teachers' formal collaboration times are structured makes a difference for cultivating deliberation expertise. Teachers use this deliberation expertise to support instructional change through strong partnerships with colleagues and shared details of their practice. This study identifies the conditions under which deliberation is supported and the ways in which schools can capitalize on this expertise to improve instruction.

Cultivating and Capitalizing on Teachers' Deliberation Expertise

Reform efforts aimed at improving instruction in schools often require collaboration between teachers. This is not surprising in light of decades of scholarship establishing the benefits that can result from such collaboration (Hargreaves, 1994; Lieberman & Miller, 2011). Given that teachers spend much of their actual teaching time alone with their students, opportunities to collaborate with other teachers can expose them to new practices and perspectives that they might not consider on their own (Coburn, Russell, Kaufman, & Stein, 2012). For this reason, access to instructional expertise in these formal collaboration settings has been the focus of important recent scholarship in this area (Horn & Kane, 2015). Yet collaboration between teachers, which often tends to be superficial, is no silver bullet for school improvement (Hargreaves, 1994; Kelchtermans, 2006; Stoll, Bolam, McMahon, Wallace, & Thomas, 2006), and instructional expertise is only beneficial insofar as teachers access and make use of it (Farley-Ripple & Buttram, 2015).

One limiting factor on the benefits of formal collaboration time for teachers is the extent to which reforms are deliberated. In order for teachers to make substantive changes to instruction, they must have opportunities to identify ways their practice might change. Rich deliberation with colleagues has been shown to make a difference for how teachers collectively negotiate their beliefs and instructional decisions (Coburn, 2001; Spillane, Kim, & Frank, 2012). Yet this type of deliberation is not guaranteed when teachers meet for formal collaboration times (Coburn & Turner, 2011; Horn & Kane, 2015), nor is it confined to these times (Coburn, 2001). Rich deliberation with colleagues may be limited by norms of privacy that prevent teachers from sharing details of their

practice (Coburn & Turner, 2011), a lack of instructional expertise (Horn & Kane, 2015), or structural features of the school context (Spillane, Reiser, & Reimer, 2002).

This study examines another type of expertise – *deliberation expertise* – within the school context. This is the kind of expertise that allows a teacher to steer conversations toward productive deliberation and facilitate a collective orientation that supports the goals of instructional reform. Because facilitating discussions has been identified as a way to deepen teachers' conversations and increase their opportunities to learn (Gibbons & Cobb, 2016; Gibbons, Kazemi, & Lewis, 2017; Marsh, Bertrand, & Huguet, 2015), reform efforts often include the addition of a coach to aid teachers' collaborative efforts. As reformers and researchers are discovering, however, the addition of a coach is no guarantee of collaboration toward instructional improvement. Coach effectiveness varies (Gibbons & Cobb, 2016; Marsh et al., 2015), and funding for coaches may be tied to reform funds that are less stable than funding for teachers. Therefore, it is important for reformers and school leaders to attend, ultimately, to the deliberation expertise and practices of the teachers themselves.

This study is guided by the following research questions:

- How does the school context shape the deliberation culture and expertise of the teaching staff?
- How does deliberation support meaningful collaboration between teachers?
- How do teachers use their deliberation expertise to support reform?

This comparative case study of the math departments of two schools undergoing collaborative instructional reforms applies a social network approach to examine teachers' formal and informal collaboration. Data collected through observation,

interviews, and document analysis provide insight into the deliberation expertise of the teachers as well as the nature of their interactions with one another within their school and department contexts.

Literature Review

Although teachers may spend most of their teaching time alone with students, their relationships with other educators make a difference for the way they frame their practice. Reforms aimed at instructional improvement in schools are communicated and deliberated among pairs and groups of educators (Coburn, 2001). This communication between educators involves the collective negotiation of beliefs and practices related to instruction and reform. Groups of teachers, even within the same school, may understand and implement the same reforms differently from one another (Daly, Moolenaar, Bolivar, & Burke, 2010).

Teachers make sense of the details of reform through deliberation with one another. In these conversations, certain topics are debated, ignored, or dismissed. Horn and colleagues (Horn, 2007; Horn & Kane, 2015; Horn, Kane, & Wilson, 2015) examined how this occurs when math teachers work together in formal groupings. They found that the way teachers discuss student ability, the nature of mathematics, and the role of teachers matters for the way they define students' problems and appropriate instructional responses. Teachers may hold conflicting beliefs, but some beliefs are voiced and used to guide discussion while others are cast aside.

Due to the pivotal role of teachers' relationships in the way teachers make sense of and enact reforms, researchers have increasingly turned to social network theory as a tool for examining these relationships. Central to this theory is the idea that resources

and ideas (e.g. knowledge, advice, attitudes) are shared in the patterns of relationships teachers have with one another. The way teachers participate in these networks affects their learning opportunities, opportunities to innovate in trusting environments, the influence they exert on one another, and the way they implement and alter reforms (Moolenaar, 2012).

Teachers' networks can be related to formal hierarchies and the organizational features of schools (e.g. grade levels, departments), but they also include informal relationships such as friendship, which may extend beyond the formal organization of a school. Both these formal and informal networks can be influential and play a role in how teachers learn about and make sense of reforms (Stein & Coburn, 2008). New networks have been shown to develop around reforms as teachers seek advice from teachers who they perceive to hold reform-related expertise (Farley-Ripple & Buttram, 2015). The way educators perceive one another's expertise, then, is important for the opportunities they have to deliberate reforms and a can be a deciding factor for whom they deliberate with. Given the variation in the way different groups implement reforms, teachers' perceptions of one another could have powerful ramifications for their practice.

Simply being part of a social network or participating in mandatory collaboration time with colleagues does not guarantee that teachers are engaging in the kinds of relationships that are conducive to instructional improvement. Relationships and collaboration do not always produce the kinds of instructional changes desired by reform efforts. Conversations between colleagues may be constrained by norms that prevent teachers from sharing the kinds of details about their practice that are vital for deliberation (Datnow, Park, & Kennedy-Lewis, 2013; Horn & Little, 2010). They may

be shaped by a strong desire to avoid conflict, thus minimizing the likelihood that teachers will address topics that would involve deliberation of conflicting ideas (Coburn & Turner, 2011; Kelchtermans, 2006). In some cases, conversations may lack participants with the kind of diversity of experience, perspectives, or instructional expertise necessary to bring about change (Coburn, 2001; Horn & Kane, 2015).

Instructional expertise is a key, though insufficient, attribute of teacher groupings. Horn and Kane (2015) cast doubt on the role of unfacilitated teacher workgroups in improving classroom instruction when they found that such collaboration only provided opportunities for the most expert teachers to learn. Less accomplished groups were unable to engage in the type of deliberation that has been shown to result in in collective reform-oriented instructional decisions. The researchers called for the addition of coaches to facilitate teachers' collaborative efforts, an addition that has been shown to be effective in many cases (Gibbons & Cobb, 2016; Gibbons et al., 2017; Marsh et al., 2015). Yet effective group facilitation does more than simply add instructional expertise to a group. Effective facilitators focus conversations in productive ways, such as on instructional practices (Coburn & Turner, 2011; Gibbons & Cobb, 2016; Marsh et al., 2015), or on student thinking (Cosner, 2011). Effective facilitators employ conversational moves and routines that produce deliberation and steer it towards improvement-oriented outcomes (Horn & Little, 2010; Park, 2017). These moves and routines are separate from instructional expertise. They represent a kind of deliberation expertise, and they are a necessary component of effective collaboration between teachers.

Another paper drawing on the same data set as the present study examined how this deliberation expertise played out during facilitated and unfacilitated conversations between middle school math educators during formal teacher collaboration meetings (Lockton, 2017). The paper examined the beliefs that teachers, coaches, and administrators expressed about research-supported reform goals aimed at instructional improvement. Educators' beliefs about whether the reform goals were feasible or not rested on three areas of explanation: notions of student capability or deficits, the nature of mathematics, and the nature of teaching.

The study found that the frequency with which teachers expressed and deliberated beliefs varied by school and work group, and that certain deliberation tactics were more likely to result in a shared orientation that supported the reform goals. Deliberation tactics that were most effective in producing a positive orientation toward the feasibility of reform goals were: rooting the discussion in math rather than teaching in general, focusing on instruction, focusing on student thinking around math, and using concrete examples of previous conversations with students or of how future conversations could unfold. For example, if a teacher argued that the reform goals were impossible to carry out with their student population, another educator might challenge this belief by explaining what specific mathematical concept students were struggling with, how these students understood related concepts, and a turn-by-turn example of a conversation that the educator has had with students in the past to clear up their misunderstandings. Using this type of approach, educators were able to cultivate the collective framing of the reform goals as feasible in their educational setting (Lockton, 2017).

Further, this study found that certain people were more effective at employing these tactics than others, and that some people (often the same individuals) were able to steer conversation towards this kind of deliberation. The individuals with the most deliberation expertise included some (but not all) coaches as well as some teachers. The current paper builds upon this work to examine how the school context provides or limits opportunities for teachers to engage in deliberation about reforms with these individuals, and how it supports a productive culture of deliberation.

Given that coaches are frequently a temporary addition to schools' networks, understanding how to grow and capitalize on the deliberation expertise of teachers is vital to ensuring that teachers engage in relationships that will help them improve their instructional practice.

Methods

In order to examine how schools cultivate and capitalize on the deliberation expertise of their teachers, this comparative case study draws from qualitative data collected in two middle school math departments undergoing multiple reform efforts. Interviews with teachers, observations of teachers' formal collaboration time, and analysis of documents related to these formal meetings and reform goals are used to identify the instructional expertise of the teaching staff, teachers' collaborative networks, teachers' formal discussion patterns, and the supporting and constraining factors of the school and departmental contexts.

Sample

Participants in this study include all of the 22 general education and six special education math teachers in the math departments at two middle schools in the same large

urban school district in the U.S. The schools, with the pseudonyms Waterford Middle School and Silverleaf Middle School, were comparable in their math departments' size and organizational structures, with both departments being broken into grade-level groups of teachers who were expected to work together.

Data for this study were drawn from the first year of a larger four-year study that involved a partnership between the school district and a university to improve math instruction through coaching, pedagogical supports, and teachers' use of student data. All schools for the wider study were selected based on their persistent low math performance in the district. The two schools in this study, and several individual teachers within the schools, were also participating in several other district and independent reform efforts. Although these reforms had slightly different foci, they were all supported by research and shared several main goals, which included:

- moving away from a focus on math procedures to a focus on conceptual understanding
- focusing on discourse as a way for all students to engage with math at a high level
- attending to students' mathematical reasoning to allow all students to access the curriculum by building on what students know (rather than focusing on building students' basic skills that are below grade level)
- working collaboratively to achieve these goals in meetings with their departments and professional learning communities

All reforms were focused on engaging all students in cognitively rigorous mathematical thinking by improving math instruction. Most reforms included a coach to

assist teachers in the implementation of the reform, and these coaches frequently attended meetings with teachers and occasionally assisted them in their classes.

Data Collection

Data were collected during the 2015-2016 school year. Math department and grade level meetings were observed and teachers were interviewed toward the end of the year.

Observations of teachers' formal collaboration meetings. Thirty-one formal departmental and grade level math meetings were observed across the two schools. Approximately the same number of meetings were observed at each school, and each meeting lasted 40-120 minutes. School administrators and/or district coaches connected with one of the reform efforts often attended meetings. Detailed field notes captured when particular educators came and went throughout the meeting, what educators said to one another, and which comments were directed to the entire group or to an individual or subgroup.

Interviews with teachers. Each math teacher was interviewed toward the end of the study year, with the exception of one teacher who declined. Interviews lasted 45 minutes to one hour and were professionally transcribed. Semi-structured interviews provided teachers with multiple opportunities to discuss their formal and informal relationships with their math colleagues, details of their departmental and grade level contexts, expectations and the role of school administrators, and experiences with changes to their beliefs and practices. The questions which produced the most data on these topics are displayed in Table 3.

Table 3. Interview Questions Related to Study Foci

Focus	Most relevant interview questions
Teachers' collaboration networks	How do you decide which instructional materials to use (when to use them, how to use them)? Is this something you do on your own or with others? How do you feel about sharing your data about your students in meetings?
Teachers' informal practice-related discussion networks	When you are not in formal meetings, do you find yourself discussing your teaching practice with colleagues? What kinds of things do you discuss? Who do you usually have these conversations with?
How teachers have been influenced by working with other teachers	Can you think of any examples of how conversations with a colleague, formally or informally, have led you to think differently about what you do in the classroom?
The role of school leaders and departmental structure in teachers' relationships	What is the role of your principal and/or assistant principal in PLCs? Is the agenda set by leadership? Does leadership play a role in the meetings?

Document analysis. Formal meeting agendas were analyzed against field notes to determine school administrators' expectations of teachers' formal collaboration times, teachers' interpretation of those expectations and of the reform requirements, and how teachers' collaborative routines aligned with or departed from administrators' expectations.

Data Analysis

This paper builds upon the results of a prior study (Lockton, 2017), which identified the ways in which educators in formal collaboration meetings voiced and deliberated beliefs about the feasibility of reform goals. Both positive and negative belief statements about the feasibility of reforms were coded, as were attempts that educators made to challenge negative beliefs. In the prior study, individuals who made these

challenges were identified, as were the types of arguments they made while deliberating these beliefs with colleagues.

Teachers who were often able to steer conversations towards a positive reform orientation are identified here as *deliberation experts*. Teachers who frequently attempted such moves but were less often successful are identified as *emerging experts*. Note that this is not an evaluation of their instructional expertise. Teachers who did not engage in the deliberation patterns of experts and emerging experts are identified as *novices*, again not due to their instructional expertise but based on their role in steering conversation.

Statements that were identified in the previous study as those which encouraged deliberation of the reform goals were examined as part of the departmental and grade-level contexts, as was the content of teachers' facilitated and unfacilitated discussions. For this, field notes, meeting agendas, and interview transcripts were uploaded into the qualitative data analysis software MAXQDA and coded for instances when teachers discussed particular topics (e.g. student data, students' mathematical reasoning, instructional strategies), voiced beliefs about the feasibility of reforms, and spoke about the structures of the school and department (e.g. role of special education teachers, expectations of school leaders, collaboration requirements, reform requirements).

Statements made by teachers during facilitated and unfacilitated formal collaboration times to the group as a whole or to specific individuals were quantified in Excel and patterns were mapped in R statistical software to create network maps of teachers' formal collaboration patterns.

Network maps of teachers' collaboration around instruction and informal discussion about their practice were constructed by coding teachers' interview transcripts and field notes for instances when teachers discussed working with their colleagues in this way. Ties were determined to be strong or weak based on descriptions in interviews and observational data. Again, results were quantified in Excel and mapped in R.

Findings

Waterford Middle School and Silverleaf Middle School appear, by several measures, to be remarkably similar contexts for the deliberation of instructional reforms. Their staffing and meeting structures are nearly identical on the surface. Yet an analysis of the interaction patterns between individuals during formal and informal meeting times reveals several differences between the way deliberation and collaboration occur at these schools. This section begins with an overview of the collaborative structures of the math departments at each school and then examines each research question in turn.

Waterford Middle School and Silverleaf Middle School had similar departmental structures. The math departments at each school were split into grade level groups that were expected to collaborate closely around the reform goals, pace their teaching of required math topics together, and gather and analyze student data collaboratively. Although each school had a teacher who was formally identified as the math department chair, these teachers had little to no role in guiding their departments' meetings. Instead, the agendas for formal meetings were set by school administrators or, in certain cases, left up to the grade level groups themselves. Formal meetings were generally structured by school administrators with the goal of encouraging deliberation about instructional practices. At both schools, many teachers also met informally to plan instruction.

At Waterford, the math department met together roughly every other month for an hour and a half with at least one school administrator present. The school administrator set the agendas for these meetings. A variety of coaches connected to the various reform initiatives also attended these meetings sporadically. In addition, teachers met with their grade level groups approximately twice per month for hour and a half long sessions. How to spend this time was left largely up to the teachers of each grade level, though the school administrators did assign them occasional tasks to complete and checked in with each grade level at some point during each meeting. Coaches occasionally attended these meetings as well. Teachers also had some full-day grade level meetings where they mostly set their own agendas and often had a coach in attendance in a non-facilitating role.

Like at Waterford, math teachers at Silverleaf Middle School experienced both department and grade level meetings. Both types of meetings at Silverleaf were less frequent, however. Math teachers met twice per month for 50 minutes, although meetings generally started at least five minutes late. One of these meetings each month was reserved for work surrounding the numerous administrative requirements of a single reform that this school had been implementing for several years. The remaining monthly meeting was sometimes spent with grade level colleagues and sometimes spent with the department as a whole. In either case, the agenda was set largely by the school administration and was often facilitated by an administrator or coach, though the facilitator was not always present. The agendas for the few full day grade level meetings that occurred sporadically throughout the year were also largely set by the school administration, and school administrators and coaches were often present to facilitate.

Although the collaborative structures of the math departments of the two schools appeared to be more or less the same, a closer examination reveals key differences in the opportunities for teachers to learn from one another.

Deliberation Culture and Expertise

This section explores findings related to the first research question: How does the school context shape the deliberation culture and expertise of the teaching staff? It begins with an overview of the deliberation expertise of teachers at each school. It then examines efforts by administrators to structure time for deliberation about instructional reforms. Finally, teachers' conversation patterns during unfacilitated discussion times are examined to better understand their meeting culture.

Observed deliberation expertise. The deliberation expertise at both schools was assessed for this study using the method explained above. This process identified a single deliberation expert among the math teachers at each school. Both of these teachers had more than seven years of teaching experience (though one had only spent a short time at the study school) and had mentored several student teachers throughout their careers. As deliberation experts, they consistently challenged beliefs that the reform goals were not feasible at their schools and successfully shifted the discussion toward an orientation that supported the feasibility of reforms. At Silverleaf, this expert also prompted these deliberations to occur. For the purposes of this study, the grade level groups at each school are identified by their deliberation practices as follows:

- Group 1: The group at each school that was most adept at deliberation about the reforms. The deliberation expert at each school was in Group 1.

- Group 2: The group at each school that engaged in some deliberation that supported the reform goals.
- Group 3: The group in each school that engaged in the least amount of deliberation about the reforms, either due to homogeneity or lack of trust.

At Waterford, where deliberation was more common, there were five additional teachers (in Groups 1 and 2) whose deliberation expertise was emerging. These teachers repeatedly challenged beliefs that the reform goals were not feasible in their settings, though their results were inconsistent. With the exception of one newer teacher, these teachers also had considerable classroom experience. The deliberation experts and emerging experts represented a mix of men and women of various ages.

The vast majority of teachers at both schools did not display conversation patterns that would place them in the deliberation expert or emerging expert category, and are thus identified as novices.

Efforts by school administrators to structure deliberation. School administrators at both schools attempted to establish norms of deliberation around reform by creating meeting agendas or goals. These are elaborated below.

Meeting structure at Waterford. At Waterford's department meetings, the school administration fostered deliberation by requiring each grade level to present their student data or on an aspect of their teaching practice. These presentations were based on the main goals of the various reform efforts underway at the school and included time and questions for discussion about the reform goals. With this structure in place, deliberation across grade levels was the departmental norm during these types of department-wide meetings. With multiple reforms and limited meeting time, however, each reform topic

was given only a short amount of time for discussion, and deliberation was often cut short in the interest of moving through the agenda. Thus, cross-grade deliberation was common, but it was often brief and not especially deep.

Although brief, these conversations encouraged discussions that aired teachers' beliefs about the reform goals and allowed them to challenge one another's assumptions. A typical example drawn from a Waterford department meeting involved a presentation by one of the grade levels on an instructional strategy they had learned through one of the reform efforts. The strategy of "revoicing" involves asking students to use their own words to describe another student's ideas. Not all teachers were convinced that the strategy was feasible. A Group 3 teacher said, "With student revoicing, you run into 'I don't know' and a shrug. On a regular basis I deal with it and I don't understand why that's what they do." This provided an opportunity for the emerging experts of Group 2 to debate with the Group 3 teachers the merits of specific strategies they had used in their classrooms to encourage revoicing.

Department-wide discussions provided multiple opportunities for teachers to discuss successes they had had with the reform goals and for teachers to practice and develop their deliberation expertise in the process. At the meetings, the deliberation expert at the school generally only stepped in to the discussion when other teachers were struggling to come to a collective agreement that a given aspect of the instructional reforms was feasible. Teachers commonly shared the floor to allow multiple perspectives. The emerging experts, with the help of the deliberation expert when needed, made every effort to ensure that a positive orientation toward the reforms prevailed in most instances. Conflicting beliefs, however, were rarely explored in depth.

These same Waterford emerging experts from Groups 1 and 2 who advocated for reforms in department meetings sometimes voiced conflicting beliefs about the reforms in the privacy of their grade level meetings. These beliefs were rarely taken up for deliberation in these settings, though when they were, they were deliberated in much greater depth with more personal details of practice than occurred in department-wide settings. Yet teachers generally avoided this kind of discussion in grade level meetings. This is despite the fact that teachers in both of these grade levels reported (in interviews) that teaching styles varied across individuals at their grade level, and that some of these methods did not conform with the reform goals. These smaller meetings were less structured by school administrators but often included at least one general task for teachers to complete. Teachers avoided deliberation about instruction or students in these settings, instead discussing topics that were less likely to include conflict, such as pacing of the curriculum, scheduling issues, and questions surrounding upcoming state and district standardized testing.

The teachers in Group 3, however, frequently discussed struggles they were having with the reform goals. These teachers reported having similar teaching styles and, thus, had little to deliberate. Therefore, while their beliefs about the feasibility of reform goals were frequently discussed, they rarely challenged one another. Instead, an orientation that supported the belief that the reform goals were not feasible prevailed in their grade level meetings.

The groups that represented the most diverse teaching styles in relation to the reform goals (Groups 1 and 2) engaged in less talk about the reforms during unfacilitated discussions. When they did find themselves in these types of discussions, however, they

had opportunities to explore conflicting beliefs in greater depth. When these teachers engaged in frequent, but brief, deliberations during department meetings, it was the emerging deliberation experts from these teams who attempted to shift discussion towards a positive orientation around the feasibility of reforms, even when some of these teachers reported preferring other teaching styles. The department meetings provided these emerging experts with opportunities to voice support for instructional reforms that they lack in their grade level meetings.

Meeting structure at Silverleaf. Department meetings at Silverleaf occurred sporadically and were generally focused on administrative tasks and housekeeping items. The time was often spent communicating expectations to teachers about the requirements of reforms. Deliberation about reform goals across grade levels rarely occurred in these settings, although the deliberation expert did attempt (unsuccessfully) to steer discussion in that direction.

Grade level meetings at Silverleaf were highly structured, with each team often working off of identical agendas in separate rooms. A school administrator or coach often facilitated these meetings. Even when facilitated, group discussions at Silverleaf, with the exception of Group 1, tended to go into only as much depth as was required to fulfill the requirements of the agenda. Goals of the reforms were communicated, even between teachers, in a procedural manner with emphasis placed on what school or district leaders would want to see when they walked through the classrooms. Silverleaf teachers were adept at explaining what they were supposed to be doing with their students, but Groups 2 and 3 did not discuss why they should be doing it or how to actually make it work in their classrooms. Conversations that delved in questions of "why" and "how"

were the norm in Group 1, however. The deliberation expert in Group 1 routinely altered the agenda to allow for deeper discussions and deliberation about the challenges teachers were facing with their classes at the time.

The following example was drawn from a meeting of Group 1 and 3 teachers and demonstrates the differences in their discussion styles. A Group 3 teacher, who was tasked with communicating school and district expectations to the other teachers, led the meeting.

Group 3 Teacher:	You guys have to be sure these [posters] are up in all classrooms.
Group 1 Expert:	It's about actually using them. Not just putting them up.
Group 3 Teacher:	[School/district leaders will be] doing walkthroughs in January to make sure you have them hanging in your classroom. … We're pretty organized. [Another teacher] is checking off the boxes. You'll also need these sentence strips up there.
Group 1 Expert:	It's about the use.

Deliberation was not the norm in any meeting setting at Silverleaf, aside from Group 1 meetings. Attempts by the deliberation expert to engage teachers from other teams in deeper discussion were not successful and ran contrary to the accepted departmental conversational practices.

Agenda items. Certain agenda items were more likely to foster deliberation than others. When the meeting structure required teachers to work together on a problem of practice that was rooted in specific math concepts, deliberation was likely to occur. Focusing on broad goals such as creating a shared assessment did not necessitate same kind of deliberation as did discussing a math concept that students struggled with. When the discussion centered on math concepts and student thinking, teachers were more able

to make the kinds of arguments in their deliberations that led to a group orientation that supported the feasibility of reform goals.

Structuring such items on the agenda was difficult, however. When requirements for such activities were overly detailed, teachers focused on completing the task as efficiently as possible rather than on deeper discussion as intended. One Silverleaf teacher described the agenda this way: "It's set by administration and we try to abide by it and get it done." When left unfacilitated, teachers frequently asked one another how they were planning on answering a question on the agenda and then filled in their forms individually to turn into the school administration. This practice was even true of Group 1 at Silverleaf, a group that routinely engaged in deep deliberation. In this group, the deliberation expert often altered the agenda to shift discussion toward questions regarding student thinking around math and instructional responses. Teachers then quickly added answers to the discussion questions at the end. Superficial discussion about prescribed agenda items was especially common when teachers were asked to analyze the results of state or district standardized assessments using the school's data analysis protocols, an activity that occurred several times throughout the year.

On the other hand, when teachers' collaboration time lacked sufficient structure, as was the case with most grade level meetings at Waterford, teachers frequently avoided deep discussion and deliberation, likely as a way of avoiding conflict. Some structure, then, was beneficial to teachers' formal collaborative efforts, but too much removed the opportunity for teachers to make the discussion relevant to their needs.

Lesson studies. There were two instances in which the school administration at Waterford supported deliberation by asking two grade levels to work together to engage

in a lesson study. The goal was for teachers to plan a lesson collaboratively with a specific pedagogical focus, select two teachers to implement the lesson while the others observed, and reflect on some aspect of the lesson at the end. In one instance, the teachers planned the lesson study but never had an opportunity to proceed further with it due to not being able to get substitute teachers for the day. In the other instance when a coach and school administrator facilitated the process, the lesson study proceeded as planned. Discussion during the lesson study planning and reflection was particularly rich with deliberation about the reform goals, as was the discussion for the planning of the aborted lesson study. Teachers discussed the details of student thinking and instructional strategies around math as they deliberated the students' ability to engage with the material, the feasibility of teaching such a lesson, and whether the rules of mathematics supported such methods.

The lesson study reflection represented a shift in the way the emerging experts in Group 2 (one of whom had taught during the lesson study) deliberated with one another. During their unfacilitated small group discussion during the lesson study reflection time, these teachers engaged in deep deliberation, playing with conflicting beliefs surrounding student ability and teaching methods that might support or impede the reform goals. The other members of Group 2 were not present for this discussion. This is the same kind of playful deliberation that took place when Group 1 had an opportunity to meet with a trusted coach to discuss instructional strategies that might help them with problems their students were having with particular concepts.

Lesson study planning and reflection consistently produced deliberation around math-focused problems of practice, though the deliberation was more sustained when

teachers felt confident that they would have access to the resources they needed (time and substitutes) in order to carry the lesson study through to completion.

Silverleaf teachers did not participate in lesson studies at their school, thus they did not have the opportunity to experience deliberation in this setting.

Unfacilitated grade level discussion patterns. The conversation patterns of each grade level group help provide additional insight into the deliberation culture at each school. At times when grade level groups met without a school administrator or coach to facilitate (either during their grade level meetings or during grade level break-out sessions at department meetings), group-specific discussion patterns emerged. Discussion during these times differed from discussions that were led by administrators or coaches in that some conversations during these meetings did not include the entire group. Each grade level followed its own discussion pattern during these meetings, which are represented in *Figure 3* for Waterford and *Figure 4* for Silverleaf. These network maps represents two levels of observed discussion patterns. The type of whole-group interaction that is usually assumed to take place during meetings is represented by bent arrows to and from the general meeting group (M).

This type of interaction was not the only pattern of interaction that emerged, however. In some cases, it was not evident at all. Another layer of interactions between specific individuals within the formal meeting time is represented by straight arrows between individual actors. These arrows represent patterns in which one individual addressed another specifically rather than the group as a whole. Interactions were determined to be a pattern and, thus, represented by an arrow, if they occurred twice during an observed meeting. Patterns were remarkably consistent across multiple

meetings with the same groups. These maps are not meant to represent patterns of deep deliberation, but instead of all conversation that took place between group members at formal unfacilitated meetings. The purpose is to understand the extent to which discussion between individuals was part of the culture of groups' collaboration time.

Discussion patterns at Waterford. The three Waterford groups displayed noticeably different discussion patterns during unfacilitated conversations (*Figure 3)*. The group with the expert, Group 1, consistently maintained whole group discussion. The emerging experts in Group 2 frequently split off to their own conversation. Similarly, the special education teacher in Group 3 (denoted by a triangle) was left out of unfacilitated discussions at that grade level. Yet, by and large, Waterford teachers were in the habit of conversing with one another.

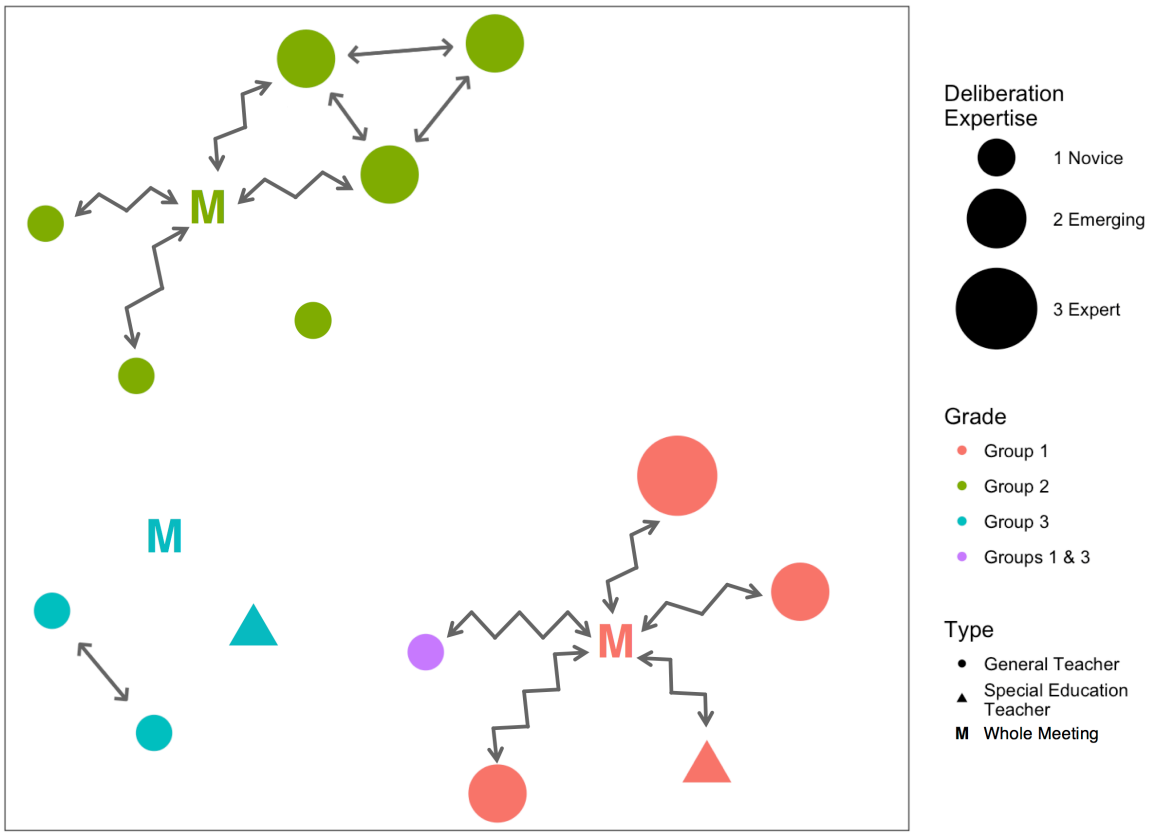

Figure 3. Waterford Middle School: Unfacilitated grade level discussion patterns.

Each grade level group included one special education teacher who worked with one or more teachers at the grade level. The special education teachers did not attend the grade level meetings as regularly as the general education teachers did, but their roles in the discussion at each grade level were consistent. It is unclear what role the school administrators expected the special education teachers to take in these grade level meetings. Special education teachers mostly described their primary role as modifying curriculum just before or during classroom instruction times rather than during formal meetings. One special education teacher reported feeling somewhat out of place at grade level meetings, explaining that "[the general education teachers] are planning…and I don't even think that's my place."

Group 1 was the only grade level to include their special education teacher in discussions. One general education teacher taught at two grade levels and attended both meetings sporadically. This teacher only participated in the discussion in Group 1. This was also the only group where discussions consistently involved all of the individuals present. Side conversations occasionally broke out during their meetings when one teacher would ask another about a particular student in their class, but these did not occur during the flow of the general discussions and are not represented in *Figure 3*.

Side conversations were a defining feature of Group 2. While most members of the group directed discussion to the group as a whole, three of the teachers consistently directed conversation only to one another. One teacher in particular, the teacher who generally avoided addressing the group as a whole, most often initiated this. This teacher often shifted the group discussion to a discussion between herself and one or two other emerging deliberation experts, leaving the other group members to sit and listen. It is possible that these emerging experts were not yet adept at engaging the novices in richer kinds of conversations they wanted to have.

One member of Group 2 did not participate in discussions at all, and other members reported, in interviews and during formal meetings when this teacher was not present, that they believed opportunities to learn from this individual may have been limited. There was not a single observed instance of the other teachers attempting to draw this individual into the conversation. This culture of conversation at Waterford, then, did not extend to this individual. Also, although the special education teacher at this grade level reported attending grade level meetings from time to time, this teacher was never observed doing so and, thus, was not included in the network map in *Figure 3*.

The formal discussion time of Group 3 involved discussion only between the two general education teachers who taught exclusively at that grade level. The special education teacher and the teacher who taught part time at this grade level both attended grade level meetings, but neither was observed speaking at these meetings unless a school administrator was present, nor was conversation addressed to them during unfacilitated meetings.

With a few exceptions, Waterford meetings included ongoing group conversation. Thus, even though teachers often avoided true deliberation during grade level meetings, they regularly carried on joint conversations.

Discussion patterns at Silverleaf. Silverleaf teachers spent much less time in unfacilitated discussions than did Waterford teachers. However, when the school administrator left the room or when a coach was present who did not take on the role of facilitator, group discussion patterns emerged. These patterns are displayed in *Figure 4*.

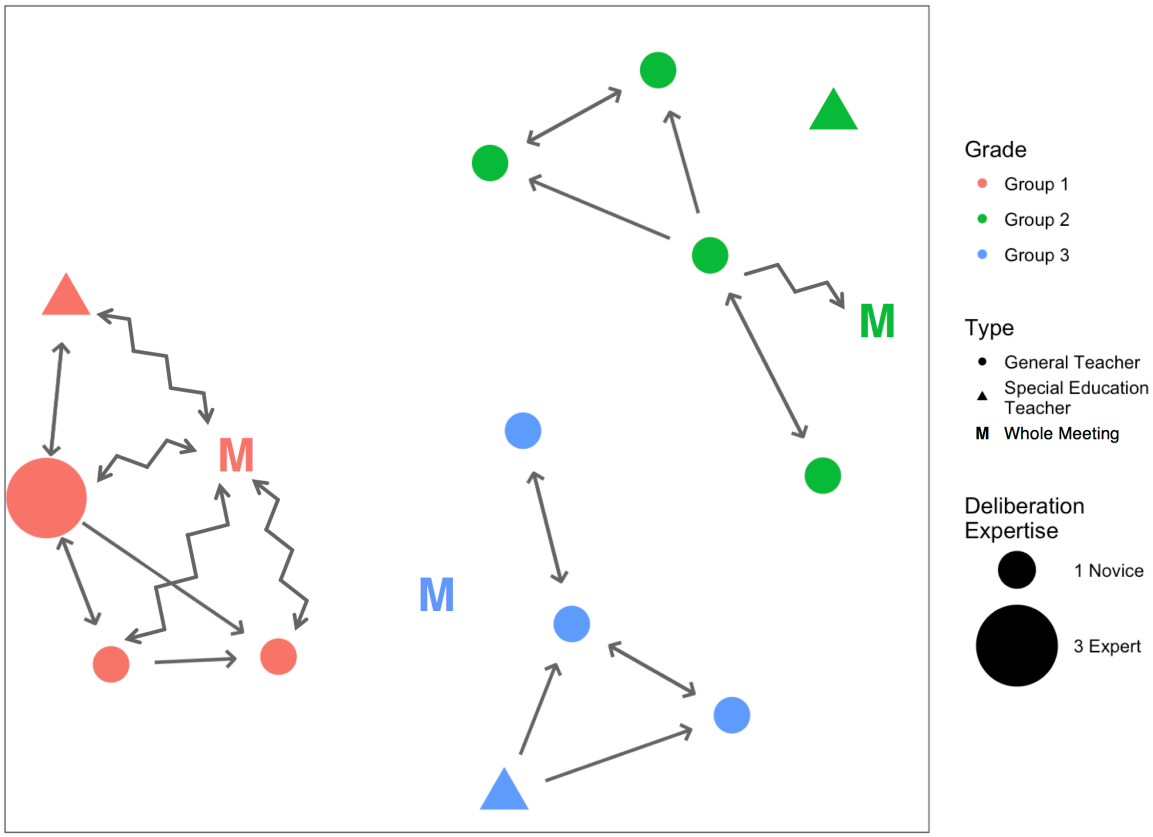

Figure 4. Silverleaf Middle School: Unfacilitated grade level discussion patterns.

At Silverleaf, only the group with the deliberation expert (Group 1) maintained group-oriented discussions in unfacilitated meetings. The other two groups (with no deliberation expert or emerging experts) were unable or unwilling to carry on whole-group discussion without an administrator or a coach to lead them. A single teacher in Group 2 was seen attempting to address the group as a whole several times, but was unable to bring about group discussion without a facilitator. In an interview, this teacher expressed extreme frustration with the lack of depth in grade level discussions. Note that even when discussions were unfacilitated, they were still generally tightly structured around an agenda or form that the teachers were required to complete and turn in to the school administration. In this way, the school administration remained involved in

teachers' unfacilitated discussions. This did little to promote conversation in Groups 2 and 3, however. It is perhaps not surprising, then, that deliberation was not a cultural norm of the department given that conversation in general was rare in most cases.

Group 1 found more success than the other groups. One member of Group 1 was new to the group and frequently dropped out of group discussion when the facilitator was not present. This teacher also expressed strong differences in beliefs about students, teaching, and math, and frequently expressed frustration with the administration's adherence to some of the reform goals. The arrows directed to individuals rather than to the group as a whole show the attempts of the group members to maintain discussion when this individual dropped out of the discussions. As the year progressed, this group was more frequently able to maintain group discussion with all members without a facilitator.

Trust and deliberation. In groups where whole-group conversation was less sustained, teachers reported less trust between one another or with the school administration.

In interviews, Silverleaf teachers in Groups 2 and 3 described low levels of trust with colleagues. This lack of trust was evident in teachers' reluctance to work closely together. Strong norms of privacy prevailed in these groups, and teachers reported being uncomfortable sharing their student data and details about their practice with one another. One Group 2 teacher described the kinds of thoughts these teachers have when sharing their student data:

> There's a lot of pressure. There's pressure for me of "How am I as a teacher? Did my students do well? How will I look?" It's a lot of comparison. You compare yourself to other teachers. I think the teachers

> that I'm involved with [are] not as judgmental because I've worked with them for years, so we kind of know each other. But when it comes to admin when they're looking at the numbers, "Hey how did [he/she] teach? Is [he/she] doing good? Does the school have the numbers? Is [he/she] going bring the numbers up?" So it's pressure.

The accountability aspect of these scores were frequently emphasized (at one point someone noted that the state test scores are "what go into the newspaper"). Changes to instruction in response to these scores were rarely revisited in formal meetings, so it is unclear if teachers were altering their instructional practices.

With the exception of one close pair of Group 3 teachers in speaking about one another, all Group 2 and 3 teachers reported a lack of trust among the staff and sharp differences in teaching styles and beliefs. One Group 2 teacher described her team as "dysfunctional." The school required teachers at each grade level to keep pace with each other in teaching the same math concepts at the same time, but how teachers taught these concepts was left up to individual teachers. Pressure to maintain a set pace was a constant point of contention between teachers and the administration. This excerpt is from an interview with a teacher who had recently met with a school administrator about falling behind in pacing.

> If I follow through the pacing guide, it's just so superficial that I feel, at the end I'm going to have more Fs and Ds, which goes against my philosophy as a teacher to instill confidence, instill the willingness to learn, instill the ability to say "well I'm not that good at this now but if I keep on practicing I'll get better." That's what I'm about. And to me a pacing guide as a pacing guide isn't anything. I thought there would be an understanding, and I guess there wasn't so I'm very disappointed now.

At Silverleaf, the department collectively focused more on ensuring that they were all complying with the reform requirements rather than aligning their thinking with the reform goals. There is evidence that teachers' understanding of their practice and

contexts can change as they make changes in instruction and see results (Guskey, 2002). However, this requires teachers to make real changes to their practice and then reflect on them. Teachers' interview responses suggest that Silverleaf teachers may not be engaging in the kind of reflection that might make instructional changes likely. It is possible that the school leaders at Silverleaf were attempting to overcome an existing lack of trust and unity among the teaching staff by providing groups detailed agendas to help guide them through formal collaboration times. The unfacilitated discussion patterns at Silverleaf provide support for this theory, since two of the grade levels refused to work together without an administrator present. Although the highly structured agendas did require teachers to interact to some degree, they were unable to build the underlying trust between the teachers or break down norms of privacy in the department.

In contrast, the same mechanisms that appear to support deliberation expertise at Waterford also appear to support trusting relationships between teachers. The most striking contextual factor that was associated with the trust required for productive deliberation was the degree to which teachers were able to share details of their practice with one another. Verbal prompts from a Waterford administrator during department meetings for teachers to discuss specific examples of how they tackle particular math topics (e.g. "How do you address this issue in your classroom?") and opportunities to observe one another and discuss their practice through lesson studies were powerful ways by which teachers broke down norms of privacy. These experiences built trust and provided opportunities for teachers to deliberate conflicting beliefs that they held as individuals and collectively. These were the trust-dependent mechanisms that appeared

to support deliberation expertise as teachers made sense of the reform goals in their contexts.

The link between trust, deliberation expertise, and discussion patterns is evident in *Figures 3 and 4*. The wider department structures at Waterford that supported deliberation expertise and trust between educators simultaneously supported grade level discussion to some extent. Those individuals with greater deliberation expertise at both schools engaged in more sustained grade level conversations. The deliberation expertise that brought the more personal aspects of teachers' practice into the open also supported deeper trust as well as deeper deliberation. Groups with a culture of deliberation grew trust and deliberation expertise while reinforcing their cultural norms.

Deliberation and Collaboration

In this section, the following research question is explored: How does deliberation support meaningful collaboration between teachers? Social network analysis provides insight into teachers' collaborative relationships and qualitative interview and observation data provide contextual considerations.

Collaboration networks. Although the formal meeting structure at Waterford supported deliberation to some degree, teachers' collaboration around instruction was not as deep as several of the reforms had intended, thus possibly limiting teachers' opportunities to engage in deliberation about the concrete details of their practice in a way that might support instructional change. *Figure 5* shows the individuals with whom each teacher reported collaborating. While reported collaboration was widespread, it was reported and observed to be somewhat superficial. Some of this collaboration occurred during formal meetings, but much of it occurred during other times, particularly for

Groups 1 and 2. No teachers reported a high degree of collaboration during the study (something that was confirmed through observation), though some mentioned that they had collaborated more in prior years.

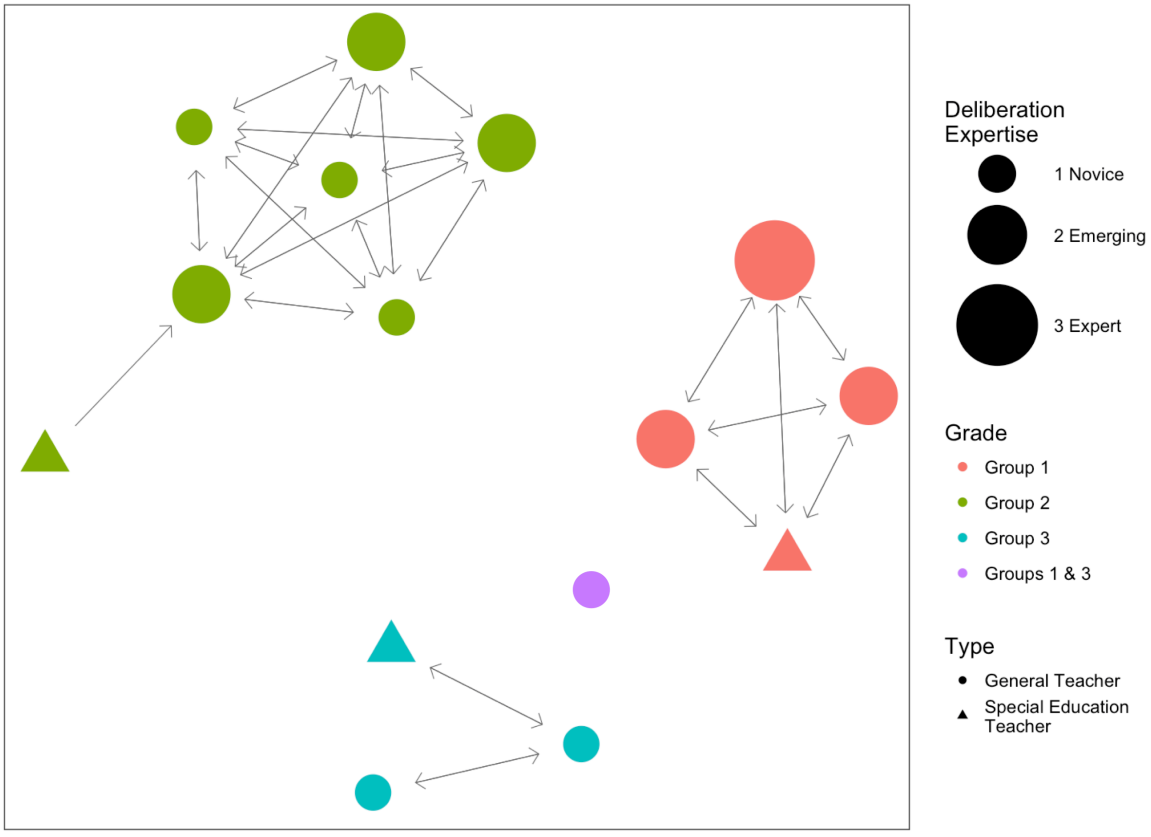

Figure 5. Waterford Middle School: Collaboration around instruction.

Although Waterford teachers reported that they believed collaboration was expected and, in many cases, beneficial, they largely identified that their level of collaboration was relatively light. They were in the habit of preparing, delivering, and reflecting on their instruction on their own. Teachers reported collaborating with one another on creating lessons and assessments, and occasionally on analyzing those assessments, but they did not report closely following the collective decisions in their own classrooms. For example, while most teachers reported an expectation at the school

that teachers would routinely use common assessments at their grade level, only Group 2 teachers reported actually doing so but also said they rarely reflected on them. All of the groups reported using different methods and lessons in their own classrooms to cover the same topics, and teachers reported little collaborative reflection about those topics or methods. One Group 2 teacher explained, "I am not a huge group planner, I know that's the way we're supposed to do it, but it's not the way I work." This lack of depth in Waterford teachers' collaborative relationships was corroborated by observation data.

Silverleaf teachers reported less widespread collaboration than did Waterford teachers, which is not surprising due to the reported lack of trust on some teams. The intensity of their reported collaboration, when it did occur, was much higher, however. Again, these findings, shown in *Figure 6*, were confirmed by observation data.

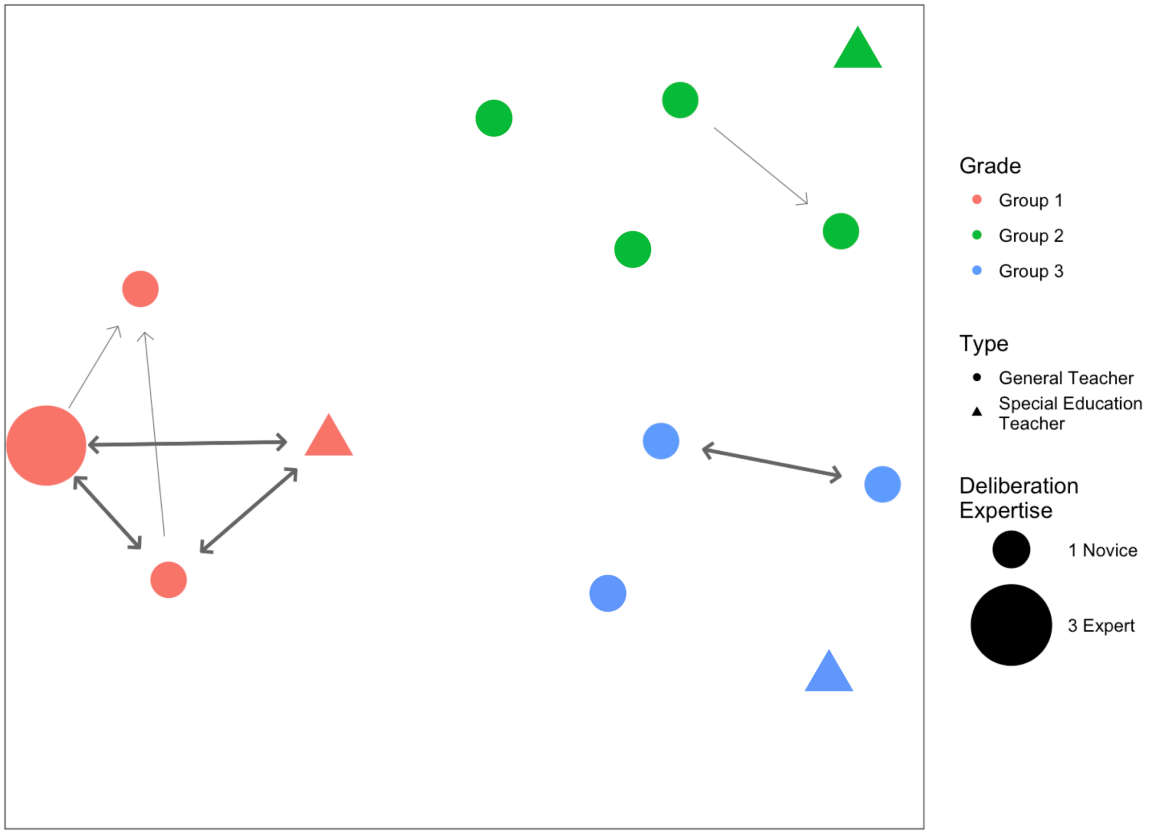

Figure 6. Silverleaf Middle School: Collaboration around instruction.

Teachers in Group 2 did not report working together on creating lesson plans, common assessments, or reflecting on their classroom experiences together. One Group 2 teacher reported collaborating with another teacher at the same grade level, but the other teacher reported a high degree of isolation on this measure. When asked to discuss collaboration with colleagues, the teacher answered, "Honestly I don't really see my colleagues besides our formal meetings. I mean, we meet weekly with staff meetings and stuff but there's always an agenda where we can't really talk about things that are not on the agenda." Isolation was a common experience reported by all other Group 2 teachers as well.

Group 3 teachers all reported that they distinctly did not work with one another, with the exception of two teachers who worked closely on every aspect of their practice. This was in the capacity of an experienced teacher assisting a new teacher by sharing lesson plans and assessments and operating as a mentor.

Group 1 again stood out as a group with an unusually high degree of collaboration. Three of the members reported collaborating closely on every aspect of their practice. Unlike the mentor relationship in Group 3, the collaborating Group 1 teachers operated as a team on equal footing, consciously seeking to learn from one another's strengths through extensive sharing of their practice. The fourth member was the new member who declined to use the same lessons as the other teachers for the year. However, as the year went by, this individual expressed increased interest in attempting some of the same lessons as the other teachers in the following year.

Structures for collaboration. Prior research has highlighted the key role deliberation plays in effective collaboration (Coburn & Turner, 2011). For this reason, one of the goals of this study was to examine how deliberation supports meaningful collaboration between teachers. Yet these findings reveal that deliberation lends meaning collaboration when collaborative structures enable deliberation and lend it meaning. The role of four collaborative structures in supporting deliberation for collective reform are examined below.

Leadership expectations. Some Waterford teachers in Group 2 reported having engaged in much stronger collaboration in prior years – sharing lessons and assessments and routinely reflecting upon those. In interviews, they explained that a change in school administration with different expectations for teachers' level of collaboration was

responsible for the change. Teachers were no longer required to collaborate with their grade level colleagues to such an extent, so they did not expend the extra time and effort to do so. Although these teachers indicated that they missed the intense collaboration of years past, they did not take measures to replicate it during the study. It is possible that other structural barriers were making it more difficult to engage in this level of collaboration than in prior years.

Shared preparation time. Waterford's Group 1 teachers also reported deeper collaboration in prior years. They explained that the change in their collaboration patterns was the result of a scheduling change that saw their student-free preparation time changed to different periods. Without that shared time each day, these teachers felt that they were unable to continue close collaboration.

The collaborating teachers in Silverleaf's Group 1 did not share preparation time during the day, but they were able to spend time together after the end of the workday each afternoon to support their deep collaboration. This was also the case with the collaborating Group 3 pair.

Physical proximity. One contextual factor that appeared to limit the degree to which teachers shared their practice with one another was the physical proximity of their classrooms. In most cases, teachers whose classrooms were farther from their grade level colleagues experienced greater isolation. Proximity alone, however, was not enough to prompt teachers to share details of their practice. This was particularly true at Silverleaf where mistrust between teachers and norms of privacy were particularly strong.

Shared special education co-teacher in the classroom. One of the most important reported and observed contributing factors to collaboration in Group 1 in both schools

was the strategic use of shared special education co-teachers. The special education teachers moved between the classes of the general education teachers, sharing practices and experiences from each and teaching lessons in the style of the other teachers. This provided opportunities for the teachers to gain specific knowledge about the practices of their colleagues along with reflection from the special education teacher regarding the outcomes of those practices. These shared details of practice were used to sustain meaningful deliberation with one another and to challenge teachers at other grade levels who, in department meetings, argued that the goals of the reforms were not feasible.

One of these special education teachers described this go-between role in the following words:

> It opens up for them eyes and ears into each other's rooms that they maybe wouldn't have otherwise. So if I heard for example [one of them] say something in class that I'm like, "Oh yeah that's a great way to explain that," when [the other] is explaining it I'll say, "Oh I heard it explained this way," and I can share that, whereas I don't know that they would be able to do that otherwise.

In Group 1 at both schools, the general education and special education co-teachers all met together frequently in short meetings throughout the day to discuss successes and challenges with their plans and ways to adjust their methods based on students' work.

At Waterford, the special education co-teacher for Group 1 was reassigned to another subject area during the first semester. The teachers reported that they felt more isolated as a result and less able to address the needs of their struggling learners. Given that teachers were interviewed toward the end of the year, it is likely that this change is partially responsible for this groups' decreased collaboration during the study compared to prior years. However, the more traditional Group 1 teacher at Waterford reported a

lasting shift in his practice over the years toward reform-aligned methods a result of collaboration with the special education teacher and the other Group 1 teachers.

The other grade levels at Waterford did not have similar special education co-teaching models. In each of those groups, a single general education teacher worked with a special education teacher who would pull struggling students out of the class for more personalized attention. Thus, not only were these special education teachers unable to share practices between multiple general education teachers, they did not even share details of teaching practice with a single general education teacher as they rarely watched one another teach.

Groups 2 and 3 at Silverleaf did have shared special education co-teachers in the classroom who were shared by multiple general education teachers at a grade level, yet they did not experience the same kind of collaboration through this arrangement as Group 1 teachers did. Existing norms of privacy and an underlying lack of trust might explain why some teachers did not use shared special education teachers as a way to share and improve upon their practice. Special education teachers reported feeling more welcome to discuss instructional practice with some of their general education counterparts than with others.

Special education teachers were an important collaboration structure in some groups that provided meaning to teachers' deliberation about instruction, which, in turn, deepened their collaboration. When this structure was removed, the need to deliberate about instructional practices disappeared and collaboration collapsed. In other groups, an available shared special education teacher provided structure for collaboration that was not used due to cultural norms that discouraged deliberation. Without a habit of sharing

details of their practice, teachers were unable to take advantage of the opportunity to collaborate to improve instruction. This is an example of the need for collaboration structure and deliberation culture to support one another for instructional change.

Role of Deliberation Expertise in Supporting Reform

This section explores the final research question: How do teachers use their deliberation expertise to support reform? To do this, deliberation expertise is examined from four angles: formal meetings, informal discussion networks, grade-level instructional change, and teachers' perceptions.

Deliberation expertise helped alter formal meeting agendas to increase the focus on math. Deliberation expertise is only useful insofar as schools can take advantage of it. Even the persistent deliberation expert at Silverleaf was unable to engage colleagues in meaningful discussion in cross-grade level meetings when a strong focus on requirements and administrative procedures was the primary collective orientation of the department. Waterford department meetings were more conducive to deliberation. Although somewhat brief and superficial, this deliberation provided teachers opportunities to practice deliberation, which, in turn, deepened the level of teachers' conversations about reforms and reinforced a culture of deliberation. Yet the structures of both schools could sometimes made it difficult to capitalize on the deliberation expertise of their teachers.

Deliberation experts at both schools frequently had to alter agendas to help negotiate a collective orientation that supported instructional reform. A typical example of this at Waterford took place when teachers had been deliberating a general teaching strategy but had run out of time before any resolution was reached. The Group 3 teachers

felt that the reform-aligned practice they had been discussing was not feasible with their students. The deliberation expert intervened and said,

> Can I help real fast? I hate to leave [the Group 3 teachers] with a sour taste. Maybe take the randomness away. When they're working, walk around and you see a student who isn't getting there. But there's another student who did and who used the same strategy. Tell the first one "another student used this strategy and she's going to share with the class. And I'm going to ask you to revoice." Or I say "I'm going to call on you next [after this student]."

This was one of several instances when the deliberation expert attempted to slow down the tight meeting schedule in order to steer the group toward an orientation that the reform goals were feasible.

At both schools, teachers were often asked to discuss instructional strategies. Silverleaf teachers often avoided these conversations, and Waterford teachers frequently discussed them in hypothetical or abstract terms. Only the deliberation experts were able to tie in specific math-focused concrete examples from their practice that resulted in a productive outcome. At Silverleaf, the deliberation expert altered the focus of the agenda to allow Group 1 to discuss math-related problems of practice that were relevant to them. Novices and emerging experts were unable to make these same kinds of moves in highly structured environments, though some emerging experts tried unsuccessfully to do so.

Deliberation expertise was associated with denser, stronger networks. The relationships of deliberation experts were markedly different from those of the other teachers in the study. Not only did these two individuals form stronger and more diverse relationships at their grade levels, but they also made greater use of the resources at their disposal (such as access to special education teachers).

Teachers' informal discussion networks reveal a clear relationship between teachers' informal networks and their deliberation expertise. When teachers were asked which of their colleagues they discussed their teaching practice with when they are outside of formal meetings, Waterford teachers' responses, mapped in *Figure 7*, reveal established and emerging relationships. Waterford teachers reported a great deal of informal discussion with one another, but in most cases, these reports were not reciprocated. Group 1 was again the exception, with most ties going in both directions. Teachers described the intensity of these relationships, which was corroborated with observation data and is indicated in the diagram with light and heavy lines.

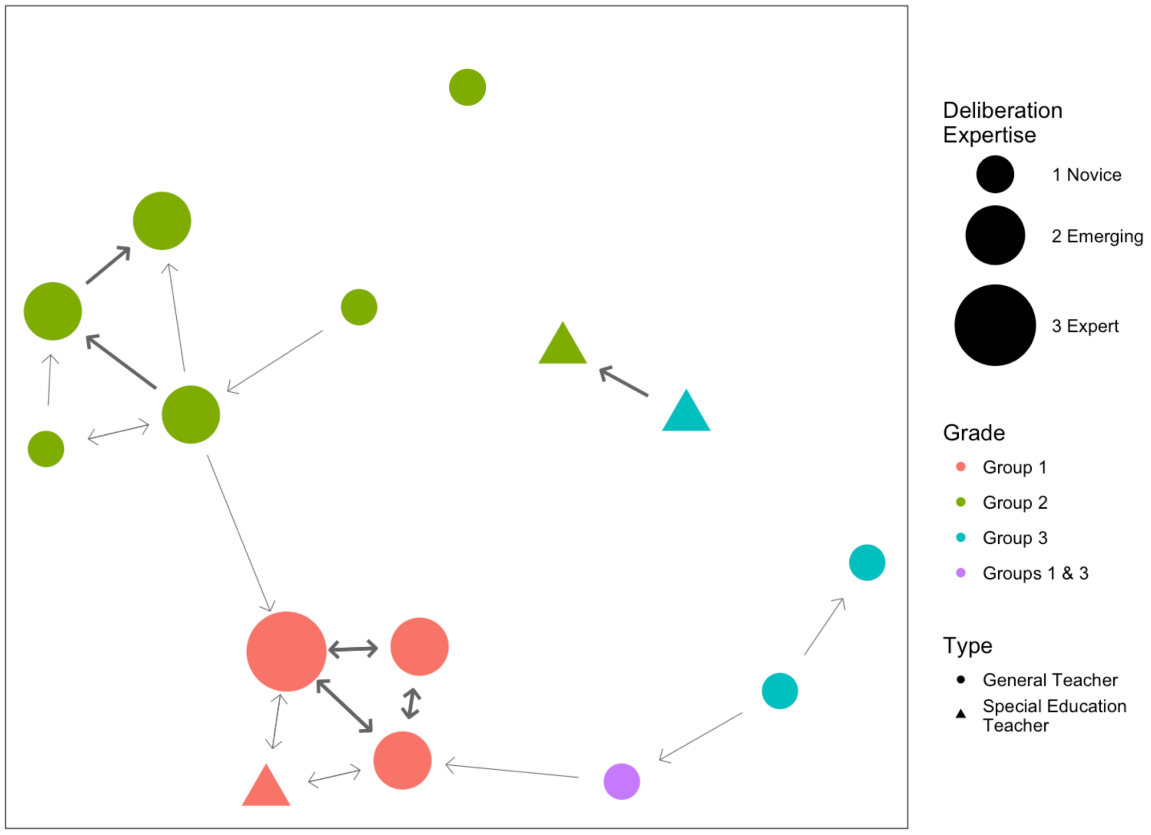

Figure 7. Waterford Middle School: Informal discussion about teaching practice.

This network shows the isolation some Waterford teachers experienced. Several teachers reported a single unreciprocated weak tie with another teacher. These same teachers also frequently expressed frustration with the reform goals and beliefs that the goals were not feasible in their settings. They reported finding little success with the reform methods thus far. None of these teachers were observed engaging in deep productive deliberation during grade level meetings or lesson studies. It was deliberation in these smaller groupings that, while less common, was more intense and most related to teachers' personal experiences.

The special education teachers for the grade levels of Groups 2 and 3 taught with a model that involved pulling students out of the general education classroom, and these

teachers reported talking only to each other about their practice. Thus, any benefits of their experience and training were not shared with the general education teachers and they were not able to share details between general education teachers about one another's methods. These individuals were not involved in creating of participating in deliberation or collaboration in the department outside of their relationship with one another.

Group 1 was the only grade level group to report strong reciprocal ties between all of the general education teachers. Interviews were conducted near the end of the year, several months after that grade's special education teacher was reassigned and was only working with one of the teachers, which may explain the weak ties to that individual.

The mix of strong and weak and reciprocated and unreciprocated ties in Group 2 reveals the complex nature of these types of relationships. Qualitative interview and observational data help explain the network of this group. To begin with, the isolated teacher is the one the other members reported little opportunities to learn from. Next, the interviews were conducted around the same time as the Group 2 teachers participated in their lesson study. Some of the interviews were done before the lesson study, and some after. One of the emerging experts who reported a strong tie with another emerging expert was new to the school during the study year, and was interviewed after the lesson study during which she shared a deep discussion with that other teacher. The other teacher was interviewed before the lesson study. If a strong relationship was forged through deliberation during the lesson study, it would not be reflected fully in this network representation.

The informal discussion networks of Silverleaf teachers, represented in *Figure 8*, again reveal the isolation of several individuals at the school and the characteristic dense networks that accompany deliberation expertise.

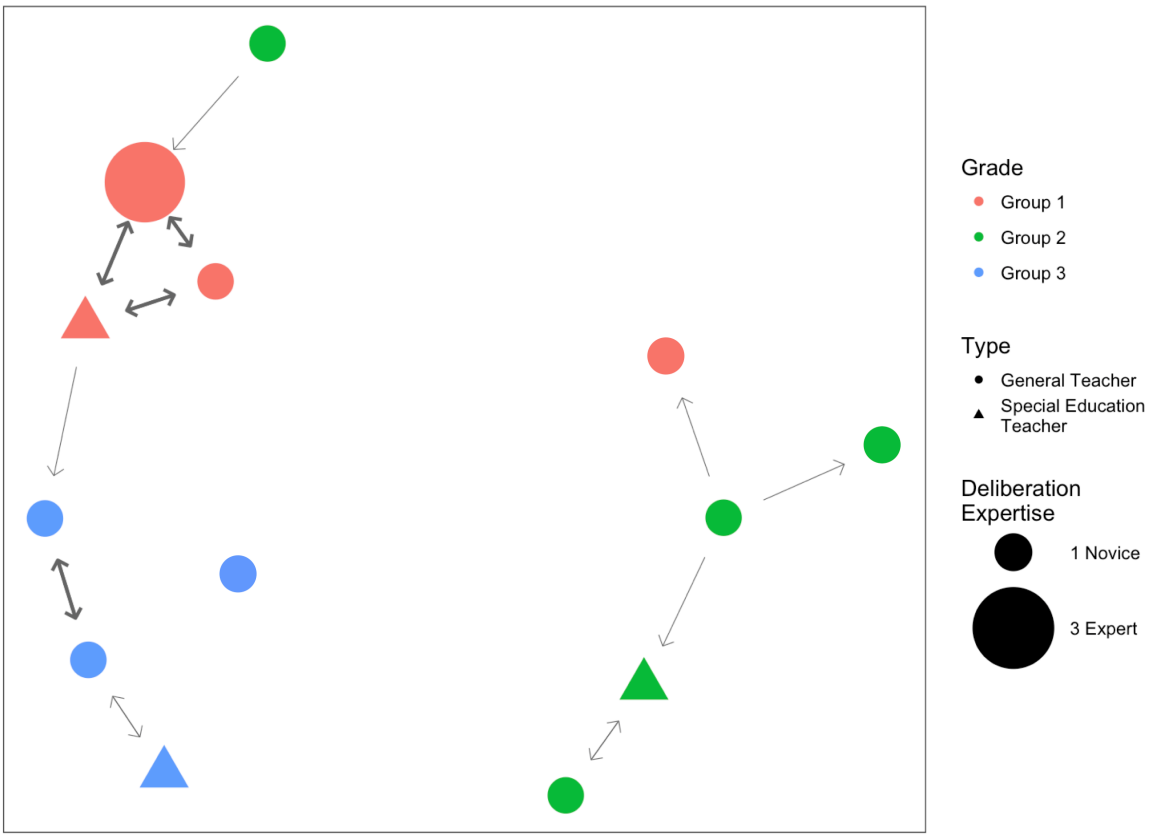

Figure 8. Silverleaf Middle School: Informal discussion about teaching practice.

The Group 1 teachers who collaborated closely also frequently discussed their practice, as this was an integral part of the type of collaboration they enjoyed. The same held true for the mentoring relationship in Group 3.

Notable was one Group 2 teacher naming the deliberation expert as someone with whom such conversations take place. Although the expert did not name this teacher in return, such conversations might seem inconsequential to the expert in relationship to the deeper grade level conversations that occur throughout the day. These conversations

were not inconsequential, however, to the Group 2 teacher. This teacher reported learning a great deal by observing the expert teach on one occasion and by the infrequent conversations that followed. This teacher was frustrated that such opportunities for interactions were not available with other Group 2 colleagues.

Deliberation experts were similar to their peers in that their social networks generally did not extend outside of their grade levels. However, the strong ties associated with deliberation expertise in these maps are the kind of ties that are important for solving problems and sharing complex knowledge (Daly, 2010). Further, the grade level networks of the deliberation experts were unique in their cohesion. Their grade levels (Group 1 at both schools) contained fewer incidents of isolated teachers and stronger relationships between members. The peripheral teacher at Waterford split time between two grade levels and taught a different type of math class than other grade-level colleagues. The peripheral teacher of Group 1 at Silverleaf was new to the grade level during the study year and reported holding very different beliefs about teaching, math, and students than did the other members of the team. However, as the year progressed, this teacher became more open to listening to grade level colleagues' descriptions of their practice and became more amenable to the goals of the reforms.

Deliberation expertise and grade-level change. Evolving beliefs was a recurring theme of teachers who worked at the same grade levels as the deliberation experts. In interviews, Waterford's Group 1 teachers reported that grade-level collaboration was integral to the ongoing development of their beliefs and practices. All of the teachers at the grade level (including the individual in question) freely discussed and joked about the more traditional, less reform-oriented style of one of the general education teachers in the

group. The deliberation expert reported intentionally attempting to alter this colleague's teaching style over the years: "The challenge for me is to try to challenge him to try new things that are out of his comfort zone." The teacher in question reported using more reform-aligned practices as a result of ongoing collaboration with the Group 1 team over the years. This teacher also frequently shared details of classroom practice to support the reform goals during wider department meetings and is classified in this study as an emerging expert. It may be that this teacher was taking steps towards instructional reform by advocating for these changes with others.

A similar scenario played out in Silverleaf's Group 1 as well. One teacher described preferring more traditional methods of instruction in the past, but deciding to attempt reform-oriented methods after hearing about them from the deliberation expert. This teacher decided to attempt these methods with the expert's guidance even without feeling a high degree of confidence that they would work: "I was like, alright you know what, I'll give it a shot, I'll do it, and it was really nice. It was surprising how much more it stuck with them. So this year I went all in on it."

The opportunity to deliberate about these methods with the expert frequently throughout the day was a deciding factor in her decision to make such dramatic instructional changes, and she cites such opportunities as a reason for her (reported) great success. In this instance, it appears that the deliberation experts' sustained efforts to transform formal collaboration time in previous years into opportunities for deep deliberation led to instructional change for another teacher. This is the same method the expert was observed to use with the newer, more isolated teacher in the grade level during the study year.

The Group 1 teachers at both schools were the only ones to take full advantage of their special education teachers, forming strong relationships and consistently treating them as full members of the grade level team. The special education teachers in both groups were a vital link between the discussion expert and the teacher whose instructional practices were under transition. Although the general education teachers had few (if any) opportunities to observe each other teach or teach together, the special education teachers helped them share minute details of each others' practice together and served as a kind of translator during deliberations, helping to clarify the general education teachers' explanations to one another.

Finally, relationships with the deliberation experts were characterized by feelings of equality and mutual respect. The grade levels did not operate with a master/apprentice dynamic. Instead, each teacher discussed having a niche at the grade level and frequently discussed the strengths and roles of the other teachers on their teams. The special education teachers in these groups also reported experiencing being full co-teachers with their Group 1 peers in a different way than they experienced with other general education teachers.

Networks and perceptions. Prior research has highlighted the importance of teachers' perceptions for the networks they develop (Farley-Ripple & Buttram, 2015). Although teachers were not specifically asked about their perception of their colleagues' instructional expertise, members of some groups frequently discussed them in interviews and during periods of observation. Many of the more isolated teachers at both schools were those whose instructional expertise was less valued by their colleagues. These teachers lost out on opportunities to form trusting relationships and to deliberate with

peers. They were also more likely to be frustrated with reforms, which is perhaps not surprising given they had the least collegial support in making sense of them.

Teachers' perceptions of one another's instructional expertise is likely responsible for many of the unreciprocated ties and subgroups in the network maps of Group 2 at both schools. Individuals reported holding informal conversations about their practice with teachers who they perceived to hold instructional expertise. At Waterford, these tended to be teachers who also held deliberation expertise. Some of the emerging experts also attempted to direct conversation during formal collaboration times along these same relationships.

It is possible that teachers are simply more willing to discuss their practice with those whom they perceive to be most able to help them. Yet examining the relationships of deliberation experts reveals how teachers with whom they work closely are able to develop greater confidence in attempting instructional practices that align with the reform goals and arguing for such practices in discussions. Perceptions may matter more, then, for those who are less adept at collective deliberation and who have less close contact with teachers who have developed this skill.

Summary

Although teachers at Waterford had opportunities to deliberate to some degree with each other during formal meetings, these discussions did not continue informally across grade levels. Waterford teachers demonstrated an eagerness to deliberate reform goals when structured meetings encouraged them to do so. The frequency of these deliberations supported by the structured discussion topics likely contributed to the emergence of deliberation expertise and to the widespread, if relatively weak,

collaboration at the site. Although the collaboration at Waterford lacked the depth intended by the reforms, weak social network ties can be important for sharing a diversity of ideas (Daly, 2010). This might prove particularly important in the coming years for those teachers who struggled to imagine how reforms could be feasible in their context. Although some of the reforms were in their first year, Waterford teachers not only understood the reform goals but also had strong opinions about how they should play out in their classrooms, which they had the opportunity to voice and deliberate in department meetings. Experiences such as engaging in lesson studies and presenting details of their practice to one another discouraged norms of privacy, adding depth to teachers' deliberations and informal networks. Those teachers with greater deliberation expertise had stronger informal relationships than their peers.

Silverleaf teachers rarely discussed their practice with their colleagues either formally or informally. There were few opportunities for teachers to deliberate changes to their beliefs and practices. Thus, teachers did not have an opportunity to develop shared ownership of the reform goals, to discuss how to attain them, or to negotiate a collective understanding that they were possible and appropriate in their setting. A lack of trust and strong norms of privacy along with an emphasis on the requirements of reforms likely contributed to teachers' feelings of isolation and were not conducive to the development of deliberation expertise. The deliberation expert worked around these contextual factors by altering meeting agendas and taking extra steps to break down norms of privacy in the grade level group, which stood out with its dense networks. However, there were few opportunities to extend these practices to the department as a whole.

At both schools, deliberation expertise seemed to be instrumental in forming strong collaborative relationships that extended beyond the formal collaboration requirements, and these relationships appeared to form as teachers practiced deliberating with one another. Further, the strong relationships of teachers with greater deliberation expertise appeared to be a function of their purposeful habits of deliberation. Yet these relationships take time to grow, and deliberation and collaboration require both structural supports and continued collective practice.

Conclusion

Horn and Kane (2015) cast some doubt on the role of unfacilitated workgroups in bringing about instructional change. Not surprisingly, there is evidence supporting the benefits of coaches with strong expertise who can guide teacher workgroups in productive ways (Gibbons & Cobb, 2016; Gibbons et al., 2017; Marsh et al., 2015). This study makes the case that schools can also foster and utilize the deliberation expertise of their teachers to support reforms. In fact, teachers who worked closely with deliberation experts in this study reported that these colleagues were the most powerful voices in challenging their assumptions and demonstrating that rigorous learning goals are attainable for students. Although schools provided teachers with numerous professional development and coaching opportunities, the close colleagues of these deliberation experts described their relationships with the deliberation experts as the ones that made them think differently about their practice. Further, this occurred without any formal designation by the school of these individuals as teacher leaders, and the relationships that these individuals formed with their colleagues were marked by equal status of all participants.

School administrators are in a powerful position to create environments that support this expertise on their staff and increase opportunities for deliberation to support reforms. However, these administrators have the difficult task of striking a delicate balance between the requirements of their district, goals of reforms, and the relationships with and between teachers. Still, school administrators can support and capitalize on deliberation expertise in several major ways.

School leaders can identify individuals who already possess deliberation expertise and increase their opportunities to engage in deliberation with colleagues around math-focused problems of practice. This requires some structure so that teachers engage in meaningful deliberation but not so much that such deliberation is stifled. Holding high expectations for collaboration and providing meaningful group tasks (such as lesson studies) can encourage deep collaboration, but groups need sufficient leeway to make the tasks relevant to them. This delicate balance of structured collaboration time is a key element of an environment that supports productive deliberation.

Leaders can provide all teachers with opportunities to develop a culture of deliberation by structuring collaboration time to include shared details of math-focused teaching practice. This provides teachers with something meaningful to deliberate and also breaks down norms of privacy. Teachers may resist sharing such details with one another if a general level of trust is lacking at the school. However, this could be one mechanism by which administrators help foster more trusting relationships between teachers. Future research might shed additional light on the role of these shared experiences in developing deliberation expertise through deepened trust and deliberation.

School leaders can elevate the status of staff members like the special education teachers in this study who have the opportunity to spend time in various classrooms. Encouraging them to be full participants in formal discussions, ensuring that they are assigned to work in the classrooms of two or three teachers at the same grade level, and providing them ample time to reflect and deliberate with these teachers can help develop their relationships at their grade level and deepen the level of collaboration and deliberation for all of the teachers involved.

Care should also be taken to avoid impeding the progress made toward deliberation. Reassigning a shared special education teacher or shifting teachers' schedules in a way that diminishes their common planning time might weaken teachers' networks and result in more superficial conversations and collaboration. Focusing on aspects of reforms that emphasize the requirements of reforms, accountability, and comparisons between teachers can contribute to a lack of trust among teachers and between teachers and administrators. This can be detrimental to deliberation.

Finally, watching one another teach (during lesson studies or with other opportunities to observe one another) was an important way that teachers in this study expanded their networks and engaged in deep deliberation with one another. Neither deliberation expert in this study participated in lesson studies, thus limiting their opportunities to build their networks. It is possible that these teachers could expand their networks beyond their grade levels if such opportunities were more common and that other teachers could develop deeper habits of deliberation with one another. This is another promising area for further study.

Given that data collection for this study was conducted over the course of a single year, it is not possible to draw conclusions about how deliberation expertise is created. Future research could focus on how this expertise is created or developed over time. Researchers could look to the experiences of those teachers in this study whose deliberation expertise was determined to be emerging to help guide their questions.

Chapter 3 is currently being prepared for submission for publication of the material.

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Dissertation Summary and Implications

On paper, the two schools in this study were doing everything they should be doing to support instructional change through collaboration. They had regular, dedicated meeting times. They tracked student data over time, gave common assessments, and met to analyze the results. They had multiple instructional coaches to assist teachers both in the classroom and during formal teacher team meetings. There were teachers at each school that reported success with the reforms, and were therefore theoretically able to provide instructional expertise to the rest of the staff. The school administrators were supportive of the reforms and of teachers' collaboration time, often attending meetings themselves. The schools enjoyed partnerships with universities and the district. By all measures, these schools have all of the ingredients in place for instructional change. However, a closer examination of the way reforms were being discussed and implemented collectively points to how difficult it is to have genuine inquiry into their teaching practice even with all of the structures in place.

The Study

This dissertation looked closely at teachers' collaboration as a way to understand how reforms played out in these school contexts. The goal of this study was to build knowledge of how teachers collectively negotiate beliefs about teaching, their students, and their academic subject when implementing instructional reforms.

Prior research has established that teachers' beliefs about their practice are shaped by experience and play a crucial role in the instructional decisions they make (Datnow & Hubbard, 2015; Fives & Buehl, 2012; Kelchtermans, 2009; Richardson, 1996; Spillane, Reiser, & Reimer, 2002). Collaboration between teachers has been shown to be an

important component to instructional reform (Coburn, Russell, Kaufman, & Stein, 2012; Daly, Moolenaar, Bolivar, & Burke, 2010; Horn & Little, 2010; Marsh, Bertrand, & Huguet, 2015). The interactions teachers have together help frame their practice and ideas about reforms (Coburn & Turner, 2011; Horn & Kane, 2015; Spillane et al., 2002). This dissertation examined these interactions in three chapters, each building upon the findings of the previous.

Chapter 1 reviewed 33 journal articles pertaining to the relationship between teachers' social interactions, beliefs, and instructional decisions. A conceptual framework outlined the mutual influence each of these elements can have on the others. In order to take hold in a substantive way, instructional reform must involve a change in the way teachers collectively define their students, their role as teachers, and the subjects they teach. Understanding the relationship between teachers' beliefs, interactions, and instructional decisions provides insight into possible avenues for instructional change and possible explanations for the lack of change in some schools and classrooms.

The qualitative comparative case study of Chapter 2 looked at conversations between teachers in math departments undergoing instructional reform efforts in order to gain an understanding of how teachers negotiate their beliefs in real time. Observation and interview data showed that deliberation about the feasibility of reforms was more likely when discussing certain topics and when particular individuals were present. Some individuals employed methods of deliberation that were more successful in steering conversations in productive ways than others

Chapter 3 examined these individuals and their contexts more closely. Qualitative interview and observation data were combined with social network analysis to understand

the relationships between educators and the kinds of collaboration that occurred in different contexts. School leaders played a central role in cultivating an environment in which the kind of deliberation that supports instructional reform could thrive.

Findings and Implications

Close examination of the content of teachers' meetings and the extent of their collaboration reveals a more complex story than is apparent at first glance. Meetings occurred like clockwork, but teachers did not often work through conflicting beliefs and problems with practice. Student data was a priority, but student thinking did not come up often in discussions. Coaches were available, but their role as leaders of collaboration and instruction was sometimes unclear. Teachers who described having success with the reforms had limited opportunities to share their expertise. School administrators struggled to find the correct balance of autonomy and control for teachers' formal collaboration time. These schools had strong foundational practices from which to grow changes in practice, but adjustments were needed to make them effective.

Structuring Collaboration

Although deliberation with colleagues has long been established as a key mechanism by which teachers make sense of their practice, understand reforms, and negotiate beliefs (Coburn, 2001; Spillane, 1999), teachers in this study did not always engage in deliberation about instructional practices during their formal collaboration time. Unless required to discuss particular topics, most groups of teachers seemed to avoid discussing ideas that would lead to deliberation. This supports Kelchtermans's (2006) work which notes that teachers engage each other in collaboration only to the extent that it does create conflict that might damage relationships. Similarly, groups with

agendas and discussion topics that were highly structured by school administrators often moved quickly through agenda items and answered required questions on a superficial level, also avoiding deliberation. This echoes what Hargreaves (1994) referred to as "contrived collegiality" wherein educators work together only to fulfill a requirement to do so. This type of collaboration is unlikely support substantive change. On the other hand, one team chose to alter or ignore official agendas in order to delve deeply into deliberation about instructional change.

Some discussion topics were more likely to involve deliberation than others. Conversations about scheduling and pacing, while common, involved little deep discussion about practice. Conversations about student data and instructional practice involved deeper conversation about teachers' beliefs, but they did not always include the kind of deliberation that is likely to support instructional change. Deliberation occurred when teachers discussed specific math-focused problems of practice, often drawing in targeted student data or examples of conversations they had experienced with students. This practice of recounting the details of past classroom interactions is an important way groups of teachers develop shared understandings (Horn & Kane, 2015). In this case, these instructional replays and the student data that teachers spontaneously drew upon were focused on student thinking about highly specific mathematical concepts. General discussions about student data or instructional practices that did not involve student thinking about particular mathematical concepts did not support deliberation for instructional change.

Implications for practice. Collaboration for instructional reform must have enough structure to encourage productive conversations between educators. School administrators in this study varied in the level of guidance they provided for teachers for different kinds of meetings, and the outcomes of these guidelines varied by teacher team. Just as students in a class have diverse needs, the supports required by each teacher team are not universal (Datnow & Park, 2015). Reform efforts must therefore include enough structure to encourage deliberation but be flexible enough for teams to have discussions that they value. Reformers and school leaders might think about collaborative structures that include broad goals, guidelines, and checkpoints, but fewer details about the paths individual conversations take. Prior research has documented positive outcomes from reforms that aim to bolster teachers' ability to set goals together and engage in joint inquiry (Gallimore, Ermeling, Saunders, & Goldenberg, 2009). Guidelines might include a focus on student thinking. Continually tying conversations in to students' thinking about particular concepts is a skill that some teachers in this study possessed, but that needed further development in most others. School leaders and coaches would likely do well to pay particular attention to drawing these discussions into teachers' collaboration time.

Deliberating Conflicting Beliefs

When productive deliberation did occur in formal settings, it did not simply involve particular individuals changing the minds of others. Instead, deliberation often provided teachers with an opportunity to explore their own conflicting beliefs.

This study supports findings from prior research that trust between collaborators is central to productive conversations (Daly & Chrispeels, 2005). Findings from this

study highlight the importance of deliberation with trusted colleagues, giving teachers an opportunity to play with ideas that may be at odds with one another. When teachers, in the absence of an administrator, deliberated teaching math concepts, they sometimes explored conflicting lines of thought, at first arguing against particular instructional methods, then arguing for them. This sometimes involved a lengthy back-and-forth process during which a single teacher might take both sides. For some teachers, this appeared to contribute to their support of reform-aligned instructional strategies.

Similarly, findings in Chapter 2 documented the conflicting positions of some teachers who routinely argued against reforms. While they were some of the most outspoken critics of some of the reform goals, they were also quick to support specific reform-aligned practices with which they had experienced success in their own classrooms. This finding raises some questions about the ways in which changes in practice can lead to changes in beliefs. It has been argued that teachers' beliefs can evolve as a result of seeing the positive student outcomes that result from changes in practice (Guskey, 2002). Teachers in the present study, however, did not always change their beliefs about their students, their practice, or their subject as a result of successes with reform-aligned practices. Instead, they were able to hold and argue for conflicting beliefs during deep deliberation with colleagues.

Some teachers demonstrated different kinds of conflicting positions. Although they publicly acknowledged a preference for more traditional methods, they also argued for reform-aligned instructional practices in some diverse collaborative settings. These teachers worked closely with individuals who were vocal about their personal successes with reform-aligned methods and had the opportunity to collaborate extensively with

these individuals as they tried out reform practices. They also reported making considerable reform-aligned changes to their practice as a result of this collaboration in recent years. In this close collaboration, they often voiced concerns about the reforms that they steadfastly supported in larger groupings. These larger groupings included other teachers who were skeptical about the reforms. Thus, their self-acknowledged reputations for traditional methods did not align with the beliefs they expressed in mixed groups. This might be an example of a person internalizing learning by explaining it to others, a tactic commonly used by teachers with their students. Teachers often discussed activities involving asking students to explain a math concept to one another in order to learn it better. It is possible that the experience of arguing for reform-aligned practices helped teachers solidify the learning they experienced in their close collaborative relationships. Prior research on expectancy-value theory in schools has found that struggling students had improved outcomes after writing essays about how particular academic lessons could be of use in their lives (Hulleman & Harackiewicz, 2009). It is possible that the same mechanisms were at work in the present study when teachers deliberated for the reform goals, thereby explaining how the reforms could play out in their own school setting.

Implications for practice. Valuable insights into future avenues for changing teachers' beliefs and practice can be gleaned from the experiences of these teachers who were most vocal in their skepticism about the reforms.

Teachers who worked with deliberation experts and then had opportunities in wider groups to take a positive stance toward reform goals were able to take the role of teacher and advocate for instructional change. It is likely that other teachers could

benefit from this pattern of close collaboration with a strong reform advocate followed by opportunities to draw upon that learning in conversations with more skeptical teachers. The logistics of putting this into practice in schools might involve opportunities for teachers to talk about their schools' reform efforts with teachers at other schools.

Teachers who argued that the reforms were not feasible in their schools should not be discounted as lost causes at their school sites. While it might be tempting for administrators to turn a blind eye to those teachers they feel are unable or unwilling to change, it might be more fruitful to help teachers identify and build upon the successes that they are already experiencing in limited but important ways. Coaches, administrators, and deliberation experts might find productive inroads with some of the strongest holdouts to instructional change by framing these successes in the context of the wider goals of the reform and using them to help teachers question their beliefs about students, teaching, and their subject.

Implications for future research. In order to better understand how teachers deal with their own conflicting beliefs, further research should examine teachers' actual instructional practice. The results of this study confirm that teachers hold conflicting beliefs about their practice (Fives & Buehl, 2012). This study documented how individual teachers discuss their practice in multiple conflicting ways. By observing teachers as they teach their students, researchers could gain a better idea of the relationship between teachers' deliberation and practice. Longitudinal studies could provide insight into how deliberation and practice change over time in the context of teachers' collaborative relationships.

Deliberation Expertise

The level of deliberation expertise of meeting participants was an important factor in the depth of teachers' discussions. This expertise involved routinely guiding discussions towards topics that led to deliberation, framing discussions in a way that supported a positive orientation toward reforms, and using student data and details of classroom practice effectively to challenge negative beliefs about reforms. Findings reveal that not all instructional coaches possessed the type of deliberation expertise that supported productive conversations, and some individuals who did possess it were teachers with no formal leadership roles. The opportunities other teachers had to engage in deliberation with these individuals were often limited by meeting topics and requirements. This is notable in large part because collaborative contexts that included more deliberation with grade level and department colleagues provided teachers with more opportunities to explore conflicting beliefs and practices and share details about student thinking and personal instructional practices. As close, trusted deliberation and wider opportunities to argue for reforms both appear to be important for teachers in making sense of reforms, contexts that structure deliberation in multiple settings appear to be better suited to support deliberation for instructional change.

Implications for research. Given that teachers described collaboration with deliberation experts as the most important contributing factor to their progress in implementing reforms, gaining a deeper understanding this of type of expertise should be of concern to researchers. Little is known about how this expertise is developed and used. Future research could examine whether deliberation expertise is tied to instructional expertise. Research is also needed to explore whether more individuals may hold deliberation expertise but choose not to utilize it or are prevented from doing so.

Further, longitudinal studies would be helpful to better understand the impact this kind of expertise has on implementing and sustaining reforms.

Collaboration Networks

This study reveals the fragility of teachers' collaboration and informal discussion networks and the fact that they take time to develop. Teachers reported changes in the way they collaborated with colleagues in recent years as a result of changes to their student-free prep periods, teaching assignments, collaboration requirements by school administrators, and special education co-teaching assignments. Teachers' formal and informal collaborations were deeper when they had opportunities to share intimate details of their teaching practice through lesson studies and shared special education co-teachers. Conversations that involve sharing specific examples of teaching particular math concepts or student data revealing students' thinking about particular concepts may help establish weak ties in teachers' collaboration networks. These ties can help otherwise disconnected individuals share novel ideas with one another (Daly, 2010). Experiences that bring teachers into one another's classrooms such as co-teaching with shared special education teachers or participating in lesson studies with one another may help forge stronger ties. Strong ties are necessary for solving problems and sharing complex knowledge (Daly, 2010). These experiences also appear to help establish the kind of trust that is associated with teachers' playful exploration of conflicting beliefs.

Implications for research. Future longitudinal studies are needed to explore the changing nature of these networks. Opportunities to collaborate closely and structural obstacles to collaboration should be examined over the course of several years to determine the role these networks play in teachers' deliberation patterns. Further, not all

teachers in this study took advantage of opportunities to share details of their practice. Future research should examine requirements by school leaders for teachers to participate in particular types of collaboration and the outcome of these requirements. Longitudinal studies could shed light on how deliberation expertise is developed, whether or not it can spread to other colleagues, and how it effects teachers' instructional practice.

Final thoughts

Although the interactions teachers at the two schools experienced with their colleagues varied, the schools were located in the same urban district with similar student populations and had both been identified as in need of improving student achievement in math. Educators in this study often struggled to imagine that reform-aligned teaching methods would be appropriate for their students. Some stated that student data only confirmed what they already knew about their students' academic deficiencies. Some worried that they were being unfairly judged for their students' low performance. While this was not true of all of the teachers in the study (indeed, many argued that their students were capable of engaging in cognitively rigorous mathematical thinking), deliberations about the feasibility of reforms involved the voicing and challenging of beliefs that might be more prominent in schools that are frequently identified as "struggling." The extent to which deliberation varies between schools in different accountability contexts needs further exploration to better understand the challenges facing instructional reforms in diverse urban schools.

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Appendix

Overview of Reviewed Literature

Source	Methods	Contributing Elements
Allen, C. D., & Penuel, W. R. (2015)	Case study of two middle schools engaged in PD regarding new standards. Interviews and teacher-created artifacts of teaching	Beliefs, reform, social interactions.
Brezicha, K., Bergmark, U., & Mitra, D. L. (2015)	Case study of a principal supporting three veteran teachers through the first year of an instructional reform. Observations and interviews.	Beliefs, reform, social interactions.
Buttram, J. L., & Farley-Ripple, E. N. (2016)	Sequential mixed methods interviews, observation, and document analysis of four elementary schools engaged in a reform to improve instruction through collaborative data use	Beliefs, reform, social interactions.
Coburn, C. E., & Turner, E. O. (2011)	Review of research on data use in schools	Beliefs, reform, social interactions.
Cole, R. P., & Weinbaum, E. H. (2010)	Social network analysis of nine high schools engaged in instructional reform efforts.	Beliefs, reform, social interactions.
Cosner, S. (2011)	Longitudinal case study of three elementary schools engaged in school-wide collaborative data use reform. Observations of teacher meetings.	Beliefs, reform, social interactions.
Daly, A. J., Moolenaar, N. M., Bolivar, J. M., & Burke, P. (2010)	Mixed methods case study of five elementary schools engaged in literacy reform. Interviews, surveys, social network analysis.	Beliefs, reform, social interactions.
Datnow, A., & Hubbard, L. (2015)	Review of research on teachers' beliefs about data use and their data use capacity	Beliefs, reform, social interactions.

Source	Methods	Contributing Elements
Datnow, A., Park, V., & Kennedy-Lewis, B. (2013)	Case studies of four elementary schools engaged in collaborative data use reform. Interviews, observations of teacher meetings.	Reform, social interactions, school culture and norms.
Farley-Ripple, E. N., & Buttram, J. (2015)	Case study of an elementary school engaged in a collaborative data use reform. Surveys, social network analysis.	Beliefs, reform, social interactions.
Farrell, C. C., & Marsh, J. A. (2016)	Comparative case study of five middle schools engaged in a collaborative data use reform. Interviews, focus groups, observations of teacher meetings.	Reform, social interactions, perceptions.
Fives, H., & Buehl, M. M. (2012)	Review of literature on teachers' beliefs	Beliefs, reform, social interactions.
Gallimore, R., Ermeling, B. A., Saunders, W. M., & Goldenberg, C. (2009)	Quasi-experiemental investigation of nine schools engaged in a collaborative inquiry reform. Focus groups, observations, interviews.	Beliefs, reform, social interactions.
Gibbons, L., & Cobb, P. (2016)	Case study of a middle school math coach work with seven middle school math teachers engaged in instructional reform. Interviews, observation of instruction	Beliefs, reform, social interactions.
Gresalfi, M. S., & Cobb, P. (2011)	Case study of a group of nine middle school math teachers engaged in collaborative reform. Observations of meetings.	Beliefs, reform, social interactions.
Horn, I. S. (2007)	Case studies of two groups of high school math teachers engaged in collaborative reform. Interviews, document analysis, observation of meetings and instruction.	Beliefs, reform, social interactions.

Source	Methods	Contributing Elements
Horn, I. S., & Kane, B. D. (2015)	Case study of three groups of middle school math teachers engaged in collaborative reform. Interviews, observation of meetings and instruction, student achievement data.	Beliefs, reform, social interactions.
Horn, I. S., Kane, B. D., & Wilson, J. (2015)	Case study of two groups of middle school math teachers engaged in a collaborative data use reform. Observations of meetings and instruction, interviews.	Beliefs, reform, social interactions.
Horn, I. S., & Little, J. W. (2010)	Case study of two groups of high school teachers engaged in a collaborative reform. Observations of meetings, interviews.	Beliefs, reform, social interactions.
Kelchtermans, G. (2006)	Review of literature on teacher collaboration and collegiality.	Beliefs, reform, social interactions.
Marsh, J. A., Bertrand, M., & Huguet, A. (2015)	Case studies of six middle schools engaged in data use reforms. Interviews, focus groups, surveys.	Reform, social interaction.
Mayer, A., Woulfin, S., & Warhol, L. (2014)	Case study of a coach's work with teachers at two elementary schools engaged in a collaborative reform. Interviews, observation of coaching.	Beliefs, reform, social interactions.
Moolenaar, N. M., Daly, A. J., Liou, Y.-H., Siciliano, M. D., & Bae, S. (2013)	Social network analysis of 431 educators in 41 schools adopting new instructional standards. Surveys.	Beliefs, reform, social interactions.
Moolenaar, N. M., Sleegers, P. J., & Daly, A. J. (2011)	Social network analysis of 775 educators in 53 elementary schools regarding innovative school climates. Surveys.	Reform, social interaction.

Source	Methods	Contributing Elements
Oláh, L. N., Lawrence, N. R., & Riggan, M. (2010)	Case study of five elementary schools engaged in a data use reform. Interviews, relevant artifacts.	Beliefs, Reform.
Opfer, V. D., & Pedder, D. (2011)	Review of literature on teachers' professional development and practices.	Beliefs, reform, social interactions.
Park, V., Daly, A. J., & Guerra, A. W. (2013)	Case study of leaders in a high school engaged in a collaborative data use reform. Interviews, focus groups, observations, document analysis.	Beliefs, reform, social interactions.
Schildkamp, K., & Poortman, C. (2015)	Case study of four secondary schools engaged in a collaborative data use reform. Interviews, observations.	Beliefs, reform, social interactions.
Spillane, J. P. (2012)	Theory-building essay on organizational routines in data use reforms.	Beliefs, reform, social interactions.
Spillane, J. P., Kim, C. M., & Frank, K. A. (2012)	Social network analysis of the advice networks of 1,210 elementary educators in 30 schools. Survey.	Beliefs, social interactions, knowledge development.
Stein, M. K., & Coburn, C. E. (2008)	Social network analysis of two elementary schools engaged in instructional reform. Interviews, observation of instruction, meetings, and informal interactions between educators.	Reform, social interactions.
Timperley, H., & Alton-Lee, A. (2008)	Review of literature on teachers' professional learning.	Beliefs, reform, social interactions.
Watanabe, M. (2007)	Case studies of three high school teachers engaged in a collaborative detracking reform. Observations of meetings, interviews.	Beliefs, reform, social interactions.