A TALE OF TWO EXPERIENCES: TEACHER LEARNING IN SELF-DIRECTED TEAMS AND OTHER-DESIGNED PROFESSIONAL DEVELOPMENT

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ABSTRACT

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The main purpose of this research study was to fill gaps in existing research on the comparative forms and qualities of learning that emerge from formal professional development and from more self-directed teacher teams. This research study also described the extent to which both align to recommendations for professional learning and the extent self-directed teams align with recommendations for detailed sharing and presentation of practice. Specifically, this research also shed light on the alignment of both professional learning and self-directed teacher teams activities to the challenges and needs described by teachers in relationship to meeting the increased challenges of the Common Core State Standards in Mathematics while using new curriculum resources.

This research study used a qualitative methodology to understand the experiences of a sample of 4th grade teachers over a period of 7 months that were engaged in formal PD and also worked in collaborative self-directed teams. Two schools located in the Midwest United States were used as research sites to study the 4th grade teams at school. Primary data sources used in this study were participant interviews, survey, and recorded video observations. These sources were analyzed to create a descriptive story of both 4th grade teams. The video observations allowed the data from the surveys and interviews to come to life to create a thick description of both teams as responses from the survey and interviews played out in real life during recorded meetings.

Initial findings from this study found two teacher teams that had a culture of trust and worked well together. However, their learning in formal PD did not appear to align with recommendations for formal learning experiences and did not align to their reported needs. While one team often used collaborative language to investigate the CCSS-M and supporting curriculum resources, the other team used student assessment data as the foundation for their self-directed learning while primarily using a closed conversation style. Both teams had members engage in formal PD experiences that were self-directed and initiated. These became a vital source of new learning for some members of the team.

A finding from this research study was the development of the intersection of formal PD and self-directed teams through self-directed formal PD experiences. These learning opportunities were initiated by either the entire team or part of the team and had a strong impact. These experiences continued to permeate the discussion at team meetings and drove the agenda at multiple meetings. However, only the participants that continued with ongoing learning experiences from the self-directed formal PD had real changes within the classroom. Understanding the stories of these two teacher teams will add the current conversations on how school leaders may best support teacher learning, but specifically, mathematics learning, at the building level and what particular conditions and contributions interact with the efficacy of formal professional development and self-directed teacher teams.

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CHAPTER 1

INTRODUCTION

In the past two decades, standards' movements have been the mainstay of federal and state education policy. Early efforts called for minimum graduation requirements, but made few demands on teachers. More recent movements, for example those detailing learning standards and high-stakes testing, weighed on teachers heavily (Louis, Febey, & Schroeder, 2005). This was very much the case with the most current expression of standards: the Common Core State Standards (CCSS).

The CCSS were developed jointly by the National Governors Association Center for Best Practices (NGA) and the Council of Chief State School Officers (CCSSO) in collaboration with teachers, researchers, and leading experts. The authors contended that the standards were not merely a new name for an old concept but a true reform in the way subjects were taught and learned (*National governors association center for best practices & council of chief state school officers*, 2010). They asserted that teachers would be required to utilize curricula and teaching strategies that would "give students a deep understanding of the subject and the skills they need to apply their knowledge" (*National governors association center for best practices & council of chief state school officers*, 2010).

Moving to a standards-based approach to curricula and assessment has received strong backing from policy makers and others hoping to increase student achievement. Through the adoption of these standards, states were hoping to transform teaching and learning by creating a common framework of curricula, assessment and accountability practices (*National governors association center for best practices & council of chief state school officers*, 2010).

There has, however, been much public debate regarding the adoption of the Common Core State Standards (CCSS) and their potential impact on K-12 schools. Some across the United States have argued that the CCSS are an overreach of the Federal government. Certain groups oppose the CCSS on the premise that curriculum should be developed at the state level (Crawford, 2014). Critics of the CCSS-Mathematics disagree with the approach of the CCSS in focusing on unfamiliar strategies to teach math. Supporters say it develops deeper conceptual understanding of mathematical content (Rich, 2014), but parents have said that the math is "tedious" and frustrates their children. Even famous entertainers are getting in the debate. The comedian Louis C.K. was celebrated by many when he said, "My kids used to love math. Now it makes them cry. Thanks standardized testing and Common Core!" (Ellenberg, 2015). However, while negatively discussed by critics and at high profile events such as presidential debates, researchers have actually found that the CCSS are supported by a majority of parents (Cogan, Schmidt, & Houang, 2013).

The CCSS are currently developed for both English Language Arts (CCSS-ELA) and Mathematics (CCSS-M). The CCSS-M include eight Standards for Mathematical Practice (Appendix A) that serve as guidelines for teacher practice in grades K through 12 (*National governors association center for best practices & council of chief state school officers*, 2010). In addition, the CCSS-M includes content standards for mathematics, organized by domains throughout grades K-12. Authors of the mathematics standards hoped to address several problems of existing curricula described as "a mile high and an inch deep" (*National governors association center for best practices & council of chief state school officers*, 2010). Research demonstrated that the mathematics curricula in high-performing countries were more focused and coherent than that of the United States. Reviews of the educational standards across the

United States showed significant variations in defining the nature of the content to be covered (Schmidt & Houang, 2012). The variance across the United States has created unclear expectations for what should be taught and difficulties in developing resources from publishers (Usiskin, 2007). The CCSS-M would help alleviate this by presenting shared expectations for mathematics curricula across the United States (Schmidt & Houang, 2012). Additionally, as students moved within schools across the United States, a common set of curriculum standards would support coherence in educational programming for these students.

Key Issues and Challenges

In order for the CCSS-M to achieve its goals, teachers needed to learn to work differently with content and with their students. For example, teachers have had to reframe their understanding of mathematical sequencing. In comparison to the previous state mathematics standards, the CCSS-M shifted learning of some topics to earlier grades. One of the largest shifts to an earlier grade level was with multiplication of fractions. The CCSS-M expects fluency at grade 5, which was earlier for forty of the forty-two states than their current standards according to the State Standards Analysis. Another shift involved standards in probability. Across previous state standards, probability spanned grades K-8. In the CCSS-M, probability is largely limited to grade 7 (Dingman, Teuscher, Newton, & Kasmer, 2013).

Another area that required teacher learning was how trajectories of learning were structured. Examples include addition and subtraction of whole numbers. Previously, instruction on whole numbers spanned across three grade levels. In the CCSS-M, addition and subtraction of whole numbers spans five grade levels. Thus, new groups of elementary teachers are teaching these for the first time (Dingman et al., 2013).

Approaches to the teaching of mathematics have shifted as the content standards focus much more on deeper understanding of concepts. CCSS-M created less of an expectation of

memorization of mathematical procedures and a much greater focus on demonstrating understanding and solving non-routine problems (Porter, McMaken, Hwang, & Yang, 2011). This has presented challenges for students but also for teachers, who required professional development focused on ways to support all students to achieve greater conceptual understanding of mathematics.

In response to the CCSS-M, school districts are adopting new mathematics curriculum materials in hopes of supporting these types of pedagogical changes. This research study provides an example of a district that is using the adoption of Everyday Mathematics 4 (EM4) to promote curriculum change in the classroom. Everyday Mathematics came out of the University of Chicago and was first published in 1989. At its core, Everyday Mathematics believes in spiraling mathematical concepts so students are reintroduced to concepts multiple times. It also aims to raise expectations for the types of mathematical tasks that students engage with by having a strong focus on conceptual understanding of mathematics. EM4 is the latest edition and was written to support the curriculum reforms of the CCSS-M and was published in 2015 ("The univesity of chicago mathematics project," 2016).

How teachers process, develop, and implement these reforms has been critical to changes in their practices. Factors such as their beliefs, prior knowledge, and attitudes shape implementation of CCSS-M (Coburn, 2001; Cohen, 1990; Olsen & Kirtman, 2002) and may also require individual and collective teacher learning. School leaders face choices and trade offs in creating learning opportunities and pathways that assist teachers to meet the challenges of the CCSS-M. One trade off concerns how much to invest in formal professional development with outside experts or specialists, and how much to support less formal, self-directed learning among teachers working in teams and learning communities. Traditionally, schools have turned to

formal PD in response to curricula reforms. Often times this meant bringing in someone not associated with the school to provide training sessions to teachers. These sessions have sometimes been described as a "sit and get" learning session with weak outcomes in terms of changes to practice (Goldschmidt & Phelps, 2010). Formal PD can, however, have positive outcomes. For example, professional learning that is sustained over time and intensive can lead to deeper levels of learning. Sustained learning should be focused on subject matter as well as larger pedagogical issues, and take a hands-on approach while being integrated into the daily lives of teachers (Garet, Porter, Desimone, Birman, & Yoon, 2001; Supovitz & Turner, 2000).

Beyond formal PD, teachers learn from working collaboratively with one another as learning communities. There are multiple models of teacher community in schools, such as school-wide teams, department teams, and specified professional learning communities (Coburn & Russell, 2008; Grossman, Wineburg, & Woolworth, 2001; Louis, Kruse, & Bryk, 1995; McLaughlin & Talbert, 2001). Moreover, teachers often hold memberships in more than one teacher community.

Judith Warren Little described the value of teacher community in her research on schools (2003). Through collaboration, she found that teacher communities could lead to individual teacher development, change in teacher practice, and in collective capacity. Others have suggested that, to influence practice, teachers' interaction must involve specific sharing of their own practices (Levine & Marcus, 2010). That is, changes to practice are more likely to occur when teachers share instructional practices frequently and in concrete detail (Levine & Marcus, 2010). Researchers have further observed that the use of "teaching replays and rehearsals"—rendering classroom events to each other—helps teachers to learn new practices. Replays and

rehearsals can "provide a figurative realm for applying general values and principles that can support professional development" (Horn, 2005).

As teacher communities may be a significant force in shaping teacher learning, providing teachers with common planning time and other supports for interaction is important (Leithwood, Leonard, & Sharratt, 1998; Louis, Marks, & Kruse, 1996). When teachers have these supports, the likelihood of forming socially cohesive, "bonded" communities where members work collaboratively with a high degree of commitment toward departmental goals are greater. (Siskin, 1994). At the same time, there is no guarantee that teacher's use collaborative time effectively. Many have commented on the range of skills and resources needed for teachers (and students) to benefit from teachers collaborative time and activity (Bryk & Driscoll, 1988; Grossman et al., 2001; Little, 2003; Louis et al., 1995; Talbert & McLaughlin, 1994).

Purpose of the Research Study

The comparative forms and qualities of learning that emerge from formal professional development and from more self-directed teacher learning communities are not well examined and bare on school leader actions. How might leaders understand what transpires under different settings and how might this understanding inform the supports they provide to teachers? This research study explored this question on a small scale through the case study of two teacher teams. Specifically, it proposed to examine the activities of a sample of 4th grade teachers exposed to formal PD on the CCSS-M and also engaged in more self-directed teacher teams. It was guided by the following questions:

1. How do the activities of a sample of 4th grade teachers engaged in a) formal professional development and b) self-directed teacher teams reflect the activities and qualities research associates with learning and changed practice?

1a. What learning activities do teachers engage in during formal professional development for implementing the CCSS-M and to what extent do these activities reflect recommendations for sustained, intensive, content focused and/or applied PD opportunities?

1b. What learning activities related to CCSS-M do teachers engage in as self-directed teacher teams and to what extent do these activities align with recommendations for specific, detailed sharing and presentation of their instructional practices for mathematics? How well do the activities align with the CCSS-M challenges they are most concerned with? How do teams negotiate individual differences in how they frame challenges, needs and team activity?

2. How do teachers describe the interaction of the formal and informal learning? In what ways do they work in tandem? In what ways do they fail to align? Or create tensions or conflicts?

Significance of the Research Study

These questions have value for school and district leaders considering how best to support teacher learning. For example, teachers often report preferences for self-directed, collaborative learning opportunities. An important empirical question is how often they engage themselves in activities associated with substantive learning and changes in practice noted above. Similarly, many formal professional development activities are judged to be ineffective. But have professional development providers become more effective at engaging teachers in more sustained and applied learning? Is it the case that each setting leans towards particular challenges and particular forms of learning? Or is it the case that both settings continue to suffer

weak practices and outcomes when compared to research findings on more promising and effective activities?

By exploring these questions, this research study has added to current conversations on how leaders best support teacher learning, but specifically, mathematics learning, at the building level. Furthermore, this research study has provided a better understanding of the activities that occur when teachers work in self-directed teams. It also has provided insights into the particular conditions and contributions that allow for interactions of formal professional development and self-directed learning opportunities.

In the following dissertation, I begin by setting the landscape of teacher learning in formal and informal settings and how teachers have worked with new mathematics curricula demands more specifically. Through this, I situate this research study within existing theory, research and also personal experience. Following a review of these literatures, I discuss the research questions and the methods for bringing data to them. Following this, I share the findings and outcomes of this seven-month study and discuss the implications and recommendations from the findings.

CHAPTER 2

REVIEW OF LITERATURE

A number of researchers have begun to look at how teachers interact with one another. Traditionally, the field of teaching was one wrought with isolation. Lortie (1975) found the field of teaching to be highly isolated. From the first year of teaching on, a teacher learns the norms of the profession, which include in large part acting as "tinkering artisans" or "independent entrepreneurs" behind their classroom doors (Little, 1990).

Little's (1990) research delved into the interactions of teachers. She found that teachers did indeed break through isolationism to work together. She termed the collaboration she witnessed as "joint work" (p. 519). Little described joint work as "encounters among teachers that rest on shared responsibility for the work of teaching, collective conceptions of autonomy, support for teachers initiative and leadership with regard to professional practice, and group affiliations grounded in professional work" (1990, p. 519). Teachers professional development opportunities in school began to bring in the ideas of "joint work" (p. 519) in order to implement various reforms. The research on effective professional development showed it can be meaningful and support a change in teachers' practice if it is sustained over time, intensive, and purposeful (Garet et al., 2001; Supovitz & Turner, 2000; K. Yoon, T. Duncan, S. W. Y. Lee, B. Scarloss, & K. Shapley, 2007). Research also showed that effective professional development allows important collegial conversations to occur and highlights the importance of collaboration to promote reform in more than individual classrooms (Darling-Hammond & McLaughlin, 1995; Knapp, 2003; Louis et al., 1996). Cohen and Hill (2001) were able to show the importance of teacher community in their work with California's adoption of a new mathematics curriculum. Their work highlighted two different professional development models used in this

implementation. Both models relied on having teachers being able to share experiences and process the reforms with colleagues.

Schools began to turn professional development into developing opportunities for teachers to formally interact in teacher communities. These models created opportunities for teachers to engage one another in dialogue and examine teaching practices. These teacher communities created opportunities for learning to be sustained, coherent, and collaborative (Darling-Hammond & Richardson, 2009) all goals of effective professional development. As schools turned toward teacher community as a model to implement educational reforms, researchers highlighted the structural conditions necessary for implementation.

Teacher Community in Schools

Structural conditions. Louis, Marks, and Kruse (1996) found certain structural conditions affected the success of implementing teacher communities in schools. Having common planning time among teachers was one of the most important factors found in their research. In their research of 28 schools, 70.5% of the variance among the schools in teacher professional community could be explained by common planning time. Wood's (2007) two and half year study of the development of teacher community also supported this finding. Wood also argued that teacher communities must be provided the space and time to create their own agendas and see them through. This finding was echoed by Wells and Feun's (2007) research on the implementation of teacher communities at six high schools. Their interview data showed how grateful teachers were for having time to meet and how this supported the development of teacher communities within their building.

Structured time to meet was important in supporting teacher communities; however, it was particularly important for the development of mutual topics of interest. Scribner, Cockrell, Cockrell, and Valentine (1999) showed in their two-year case study of 27 schools that how

teachers are organized in their work day can contribute to outcomes of teacher community and change in teacher practice. They found that when teachers were placed and worked in grade-level teams, the information about school improvement was shared more routinely. An additional benefit from arranging teachers in such teams was formal meetings were found to be more productive as teachers in grade level teams had time to previously discuss agenda items.

In a case study on conditions supporting teacher community in schools, Leithwood, Leonard, and Sharratt (1998) also highlighted the importance of school structures. They found that weekly planning meetings, common planning time for teachers, and frequent and informal problem solving sessions increased learning among teacher communities. This idea was studied further by Schechter (2005) in attempting to understand organizational learning and the concept of "Organizational Learning Mechanisms." He defined Organizational Learning Mechanisms (OLM) as "structural and procedural institutionalized arrangements for collecting, analyzing, storing, and disseminating information relevant to the performance of the organization and its members" (p. 575). Schechter used qualitative case study methods to research OLM's at a middle and high school on the same campus. He found that teacher communities built into the work of teachers, such as monthly faculty meetings and monthly subject departmental meetings, created opportunities and capacities for teachers to improve teaching and learning through interactions with each other. One middle school teacher in his study validated this by saying their teacher communities were "a place where new ideas with regard to curriculum are brought up. It is very effective because people bring personal perspectives and create new products and materials" (p. 581).

Another structural condition researched in association with professional teacher community is the size of the school. Lee and Smith (1996) used the (NELS:88) data set to look

at the effects of school size and the organization of teachers work on students. They found that school size was a factor in developing professional learning communities, with smaller schools better environments for both student learning and teachers' professional learning.

Multiple taxonomies. One tension existing within research on teacher community is the multiple taxonomies used to describe it (Horn, 2005). McLaughlin and Talbert (2001) created awareness of the implications of how the term community was used. Studying departmental differences within high schools, McLaughlin and Talbert described different types of teacher communities within the same schools. They found that teacher communities "differ in strength of mission, that is, in whether or to what degree shared goals and values support a sense of community" (2001, p. 63). They used the term "weak teacher community" to describe a community that values individual values and beliefs. They also found departments that demonstrated strong teacher community and labeled them as either a "traditional community" or a "teacher learning community" (McLaughlin & Talbert, 2001, 2006). In a traditional community, teachers are often united by curriculum traditions and beliefs that high rates of failure are a sign of a difficult subject material and students who differ in their ability to succeed. In these teacher communities, there is also inequality in the professional rewards among teachers, with teachers with the most expertise more often teaching the strongest students (McLaughlin & Talbert, 2006).

They also categorized some teacher learning communities as groups that collaborated to design new practices to engage students in learning. These learning communities believed that all students could achieve at high levels and used authentic, performance-based assessments for continuous feedback. Teachers took turns and rotated courses to ensure all students had an opportunity to be taught by the most expert teachers (McLaughlin & Talbert, 2001, 2006).

Siskin (1994) also focused on the interactions of subject departments at the high school level. In her analysis of high school departments, she created a framework to describe the different types of teacher communities formed within them. The four types of subject department teacher communities she observed were:

> 1. *Bonded*: socially cohesive community where members all work collaboratively with a high degree of commitment toward departmental goals.
>
> 2. *Bundled*: inclusion is high, but commitment to a common purpose is low: teachers support each other when needed and coordinate their efforts, but still preserve much of the image of individual artisan.
>
> 3. *Fragmented:* low in terms of both commitment and inclusion
>
> 4. *Split*: strong commitments to common goals, but loyalties and inclusion are split between conflicting factions (1994, p. 100).

Westheimer's (1999) study of two middle schools provided insight into the formation of teacher community in schools. Observing how teachers at both schools interacted, he developed the terms *liberal* and *collective* community. A liberal teacher community was based on individual rights and responsibilities and was composed of teachers working toward various, independent goals using their own practices. In a collective teacher community, members coalesced around shared, interdependent goals and participation in the community was seen as important. In a collective teacher community, teachers pursued work collaboratively and there was a free exchange of ideas (Westheimer, 1999).

Researchers have also shed light on teachers working together in community across departments. Grossman, Wineburg, and Woolworth (2001) provided a model for conceptualizing teacher communities across departments. Their work highlighted the dual nature of teacher community as focusing on student learning while combining avenues for teacher learning. They based their model on interdisciplinary teacher communities consisting of social

studies and language arts teachers. In their observations of these interdisciplinary teacher communities, teachers were more likely to engage in issues of teaching and learning because participation broadened beyond departmental politics. They highlighted the challenges in forming interdisciplinary teacher communities in navigating the tensions between professional development aimed at learning new pedagogical approaches and one that sought increased subject matter knowledge. Creating an interdisciplinary community required teachers to engage in "both intellectual and social work-new ways of thinking and reasoning collectively as well as new forms of interacting interpersonally" (Grossman et al., 2001, p. 973). Overall, their research supported efforts to foster interdisciplinary teacher communities to provide intellectual renewal and learning, to cultivate new leadership and to focus on student learning.

Richard Dufour and Robert Eaker (2004; 1998) are best known for their work introducing teacher learning community to local school districts. They referred to teacher communities as *professional learning communities* (PLC). A professional learning community "creates an environment that fosters mutual cooperation, emotional support and personal growth as they work together to achieve what they cannot accomplish alone" (DuFour & Eaker, 1998, p. xii). The main characteristics of their PLCs were shared mission, vision, values and goals, collaborative teams, collective inquiry, action orientation and experimentation, continuous improvement, and a results orientation. In a professional learning community members strive for consensus as a means to move forward with their shared work (DuFour et al., 2004).

A key element the DuFour model of professional learning community is a focus on results versus activities. Dufour argued that teachers focused only on what they do each day in the classroom and paid very little attention to what students were actually learning (Dufour, Eaker, & Dufour, 2005). He also found teachers often attributed student performance on

assessments to individual student ability versus viewing results as something teachers can affect independent of other variables among students (DuFour & Eaker, 1998). In their model, educators asked themselves, "What evidence do we have that all students are learning at high levels?" Teachers are encouraged to develop common assessments to identify students who are not learning at high levels and need additional support. The results from these assessments are used by groups of teachers to stimulate and inform adjustments in their practice to better meet the specific needs to their students.

Louis, Marks, & Kruse (1996) developed the concept of school-wide professional community from their analysis of quantitative and qualitative research data from 24 restructuring schools. Their findings focused on three main areas. The first was the concept of professionalism, which includes a shared technical knowledge base among teachers, having control over those entering the profession, and a client-orientation as a norm of interaction. The second emphasis was the concept of community, which focused on the importance of shared values and norms, the sense of responsibility for the common good of the organization, and the need to promote caring between individuals. The final emphasis was on professional and organizational community and supported a universal knowledge base and values, caring relationships, and climate as elements. Louis, Marks, & Kruse (1996) stated, "Instruction becomes more than the endeavors of individual teachers in professionally isolated classrooms, emerging as a collective enterprise in which teachers strive together toward common goals for student learning" (p. 764). Teachers operating in these types of school-wide professional communities often had higher expectations for their students than those without these common goals (Bryk & Driscoll, 1988).

Louis et al. (1996) determined that a minimal level of the following elements in a school-wide professional community:

1. Shared Norms and Values: Members of professional communities must have common beliefs as they relate to teaching and students. There has to be unified belief that students can learn.
2. Collective Focus on Student Learning: Teachers must work together to discuss issues directly related to student learning.
3. Collaboration: The sharing of teaching expertise must exist to learn from others and to understand new research and data.
4. Deprivatized Practice: Teachers must be allowed to move beyond their classrooms and work in a variety of contexts such as mentor and observer.
5. Reflective Dialogue: Allowing for this creates self-awareness among teams as to assumptions in which they operate. This allows for a better understanding of teaching and learning (p. 760-761).

Bryk, Camburn and Louis (1999) added to this concept of school-wide professional community as they discussed school-wide professional community as governing teachers' actions through the development of shared norms focusing on the improvement of teaching and learning. They highlighted the need for a collective responsibility across the school for school improvement. By having professional community norms, such as reflective dialogue, peer sharing, collegial supports, and a sharing of work through collaboration, schools often achieved better outcomes, such as increased learning and student achievement (Bryk, Camburn, & Louis, 1999).

Issues within teacher communities. Participation in formal teacher communities has been shown to change teacher practice and pedagogical beliefs (Bidwell & Yasumoto, 1999; Scribner, Hager, & Warne, 2002). There is also, however, research demonstrating that formal teacher communities do not always have a positive effect on teacher learning. Hargreaves (1994) cautioned against the blind assumption that collaboration and collegiality only or always create positive outcomes for both students and teachers. As discussed earlier, collaboration and collegiality are seen as avenues to decrease the teacher isolationism that permeates the field. However, Hargreaves argued that "individualism has come to be associated with bad and weak practice, teacher deficiencies, and things that need to be changed, yet in practice, individualism has other meanings and connotations which are not nearly so negative in character" (1994, p. 171). The power to make independent decisions, to make personal decisions about curriculum and lessons is important to many teachers. If the requirements of schools force teachers to work together, and if collaboration is seen as an erosion of these personal choices, unhappiness and dissatisfaction may result (Hargreaves, 1994).

Hargreaves recognized a delicate balance needed for an authentic and productive collaborative culture to exist. For Hargreaves, genuine collaboration and collegiality emerged where working relationships among teacher were spontaneous, voluntary, development orientated and pervasive across time and space. Contrived collaboration or collegiality was where collaboration is administratively regulated, compulsory, implementation-orientated, fixed in time and space, and predicable. Hargreaves also argued that leaders who mandate collaboration and collegiality make

> it difficult for programs to be adjusted to the purposes and practicalities of particular school and classroom settings. It overrides teacher professionalism and the discretionary judgment that comprises it. And it diverts teachers' efforts and energies into simulated

> compliance with administrative demands that are inflexible and inappropriate for the settings in which they work (1994, p. 208).

Even though teachers may be working together in a community, their work is not that of a community. Grossman, et al. (2001) coined the phrase pseudocommunity to describe groups whom act as if a community with shared norms, values and beliefs already exist among them. These communities relied on the elimination of conflict in order to maintain their group dynamics. Norms of interaction in these groups included not challenging others, not asking for clarification, acting as if the group agrees, maintaining perpetual consensus, and regulating speech in the group by allowing a group leader to dominate the conversation. No effort was made to obtain the thoughts of members of the group who are less vocal, conflict was a "behind the scene" activity, and they maintained the identities of individuals as social roles that individuals are comfortable with (Grossman et al., 2001).

In her mixed-method study of two school-wide teacher communities, Achinstein (2002) found that when teachers engaged in professional learning communities, conflict often emerged between members. Her research showed that putting educators into school-wide professional communities often created a multitude of beliefs that conflicted with one another. She found that participation in professional learning communities was strongly associated with how these communities manage differences amidst their collaboration. She contended that understanding conflict was vital to having a complete understanding of professional learning communities According to her, "The processes of conflict are critical to understanding what distinguishes a professional learning community that maintains stability and the status quo from a community engaged in ongoing inquiry and change" (2002, p. 446).

Informal teacher community. Research on supportive structural conditions and different models or taxonomies of teacher community reflect issues in the formation of *formal, intentional* teacher communities. Support for formal communities may, however, "reflect the unstated belief that 'if you build it, they will learn'" (Levine & Marcus, 2010, p. 397). Differences in the *informal interactions* within teacher communities may explain differences in teacher learning and speak to the development of *informal* teacher communities. In Hargreaves' (2001) qualitative study of 53 elementary and secondary teachers, he examined the emotional dynamics of teachers' relations with their colleagues. This research added to the literature of better understanding the dynamics occur when teachers work together. Hargreaves (2001) found that teachers value "personal closeness and emotional support" with colleagues; however, the depth of these interactions appeared to be at the surface level (p. 518). In contrast, teachers did not report to engage one another in critical dialogue of teaching practice. In fact, only one of the 15 schools seemed to value "robust professional dialogue" (p. 519). In fact, outside of this one school, teachers viewed conflict and disagreement as something negative and brought about negative emotion with one teacher reporting the she finds "there are a lot of personality conflicts and issues among teachers…I just try to avoid them" (p. 520).

Louis, Kruse, and Byrk (1995) documented a practice many teachers were not accustomed to in their practice. They advocated for allowing teachers to become coaches of one another in teacher communities. Teachers should share, observe, and discuss each other's teaching practices. This type of coaching may seem to be more natural in informal communities as teachers may feel closer to colleagues they have chosen to work.

Informal interactions among teachers may be a powerful force in shaping teachers' instructional practices. Coburn (2001) put forth a model for understanding how small groups of

individual teachers informally come together to understand policy messages and work to implement those messages within their classrooms. Schools face changing policy and curriculum decisions in what seems like a rollercoaster ride for some veteran teachers. In managing policy driven changes to curriculum, pedagogical practices or assessment, teachers tended to turn to their colleagues to make sense of them (Coburn, 2001). Even though formal group interactions were sometimes provided to teachers, they usually sought out teachers whose philosophy and practice were similar to their own to discuss possible changes to their classroom (Bidwell & Yasumoto, 1999). These informal interactions occurred before and after school, during lunch, and in the hallways of the school (Coburn, 2001). Coburn stated the influence of outside message on instructional practice was shaped by:

> (1) the patterns of interaction among teachers, specifically who is talking with whom in what setting, and (2) the character of conversation, specifically the extent to which conversations are structured to provide conditions for engagement and reflection (2001, p. 152).

Leadership within teacher community. There has also been a lot of focus on the role of leadership and its impacts on teacher community (Keedy, 1999; McLaughlin & Talbert, 2001; Printy, 2008; Supovitz, 2002; Wiley, 2001; Young, 2006). Wiley (2001) was one of the first researchers to specifically look at the relationship between leadership and professional teacher community. Her study used the National Education Longitudinal Study of 1988 (NELS:88) to quantitatively look at the relationship between transformational leadership and professional teacher community and the impact on student achievement. She defined transformational leadership as a leader who "leads by developing shared values and beliefs about teaching and

learning, supporting the actions focused on development of instruction, and communicating respect for teachers" (Wiley, 2001, p. 4). Through her HLM analysis, she found that transformational leadership positively affected student achievement in mathematics when there was below average professional teacher community in school; however, professional teacher community only increased student achievement in mathematics when there was a presence of transformational leadership in the school. She contended the principal or department chair influenced this professional teacher community by being accessible and having knowledge of matters that are important to teachers while collaborating with teachers on instructional issues (Wiley, 2001).

Printy (2008) used the (NELS:88) data and hierarchical linear model (HLM) to examine nested relationship between leadership at the building and department level and the participation of teachers in communities of practice. She described formal leaders as interacting with teacher communities in three distinct ways: agenda setters, knowledge brokers, and learning motivators. Leaders as agenda setters determined policy messages that were communicated to teachers and set goals for teachers' work. Knowledge brokers was stated to mean the actions of leaders focusing teachers' attentions to instructional matters and facilitating the meaning and alignment of instructional topics across communities. Leaders as learning motivators developed positive relationships with teachers and held teachers accountable for results.

Her analysis suggested that principals "who communicate clear vision, support teachers, and buffer them from outside influences," positively affect teachers' participation in communities of practice (p. 211). In addition, she found that department head leadership influenced the participation in communities of practice more than that of the building principal.

These findings supported Wiley's (2001) work and helped to add specificity to the discussion of leadership and teacher community.

In her work, Keedy moved past formal leader roles to examine the influences of informal teacher leaders. Her case study took place over a two-year period in a rural, southern school district and looked at the instructional leadership of two teachers as collegial group facilitators (Keedy, 1999). In one of the teacher communities, the designated teacher leader immersed herself in learning along with the group. She offered her own personal experiences and encouraged others to share ideas. From observational data, the leader of this group earned the trust and respect of her group members. In the survey data, teachers reported this leader had accomplished this by providing technical support to the group, maintained task orientation, and encouraged teacher professional growth (Keedy, 1999). The research examined teacher mediated effects upon leadership. The findings confirmed the importance of group leadership.

Building upon studies of teacher leadership, Supovitz (2002) investigated differences between teachers working in teams compared to colleagues who did not team. He found evidence that teachers who worked with other teachers "felt more involved in a variety of school-related decisions" (p. 1604). This aligned with research conducted by Scribner, Hager, and Warne (2002) on the role of micropolitics in the development of professional teacher communities. They found having a strong professional community was influenced by micropolitics and the principal's actions to build a shared identity in an environment predicated on professional autonomy.

Wahlstrom, Louis, Leithwood, & Anderson (2010) also researched links between leadership and professional learning communities. They conducted a large scale, mixed-method study of relationships between school leadership and multiple facets of teaching and learning in

180 schools in 43 school districts across nine states. Data was collected from stakeholders across all levels of each district's organizational chart. Their findings showed that teachers do need to work together to improve teaching practice and student learning but also that administrators need to part of the community. Principals need to have some role, such as participation in professional development or even rethinking the organization of the school to empower professional communities. Their research showed that shared leadership, meaning inclusion of teachers in formal-decision making and leadership roles, supports the development of professional teacher communities. They hypothesized this by saying, "Sharing leadership may have its greatest impact by reducing teacher isolation and increasing commitment to the common good" (p. 10).

While Wahlstrom et al. (2010) looked at the concept of shared leadership, Young (2006) studied how organizational conditions shape teachers' use of data in professional teacher communities and the role leadership had in supporting this. The study used a case study method to research grade level teams in four schools across two different districts. She found that principals needed to be "agenda setters." Agenda setting assisted teachers in working together, especially when principals conveyed which messages were important for teachers; agenda setting by school leadership can foster norms of collaboration among teachers. By providing a focus on data use, building leaders in this study were able to create common goals for staff. Building leaders that wanted to create systematic data use needed to "embed teaching and learning" into the activities of the school. It was found in order to influence teachers collaborative work around data use that leaders needed to be intentional in creating opportunities for staff to work together (2006, p. 544).

Mathematics Reform

Though the development of the CCSS-M is a recent reform, calls for mathematics reform have risen among educators for decades. As early as the 1950's and early 1960's, national mathematics reforms efforts sought the creation of new curriculum materials. In the 1970's, Max Bell (1974) wrote of the need for "future citizens" to move beyond mere calculation skills for success in life. In a statement very much ahead of his time, he argued that the mathematics in elementary and middle schools should be much more child-centered and create a less "bookish" and less abstract environment for students (1974). Many of the reforms he called for became reality with the Common Core's emphasis on teaching for conceptual understanding. (In an interesting connection to this study, Bell was one of the founders of Everyday Mathematics.)

Many argue that past reforms and reformers failed to understand the "central role of the teacher in classroom practices or to anticipate the power of teachers to misinterpret, subvert, and even ignore unfamiliar curricula (Remillard, 2005). To better understand the role of the teacher, Remillard and Bryans (2004) qualitatively looked at how teachers in a school used new curriculum materials aimed at instructional reform. Their findings found that a teacher's orientation toward a curriculum influenced their engagement with the materials and how they were used in the classroom. They found that teacher's conversations during monthly meetings with colleagues supported their understanding of curriculum materials, as well as, actually doing and discussing new mathematical tasks, influenced how they approached new curriculum (Remillard & Bryans, 2004). They contended that teachers using similar curricula could benefit from opportunities to explore content and talk with colleagues about how to teach it. They called for further research to develop "greater understanding of how teachers engage curriculum materials that are unfamiliar in format and content" (Remillard & Bryans, 2004, p. 385).

Teaching mathematics is not an easy task. Not only does research underscore the importance of a high level of content knowledge, but teachers must also possess knowledge on how to represent mathematical concepts, provide explanations for mathematical algorithms, and effectively analyze students' thinking and understanding of math (Hill, Rowan, & Ball, 2005). In their quantitative study to understand the effects of teachers' mathematical knowledge on student achievement, Hill, Rowan, and Ball found that reforms and practices to improve teachers' mathematical knowledge through "content-focused professional development" improved student achievement (2005). They called for research on the effects of mathematics instructional methods and curriculum materials on student achievement and posed the question: "How does teacher knowledge interact with instructional methods and curriculum materials" (Hill et al., 2005).

Teacher Professional Learning

It is important to add here understandings from some of the broader literature on formal professional learning in schools. Darling-Hammond and Richardson advocated for high quality professional learning to be available to teachers if they are expected to teach more complex and analytical skills, like those found in the CCSS-M (2009). Wilson and Berne (1999) have referred to the lack of coherent structure of professional learning as a "patchwork of opportunities-formal and informal, mandatory and voluntary, serendipitous and planned" (p. 174). However, there is a growing body of research as to what constitutes effective professional learning. More specifically, recent work has begun to work to link student results to professional learning (Guskey & Yoon, 2009). Learning Forward, a leading organization that works with educators in design and implementation of professional learning, put forward a logic model (Figure 1) in connecting professional learning with changes in students results (*Quick reference guide: Standards for professional learning*, 2016).

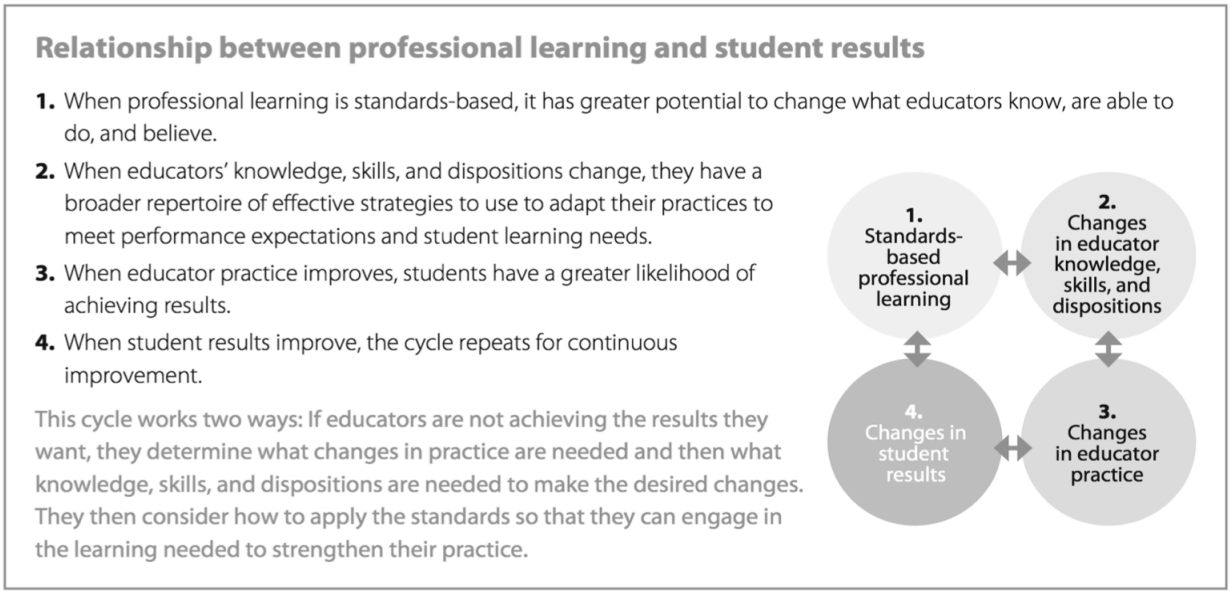

Figure 1. Learning Forward's logic model of professional learning

While *Learning Forward* provided a theory or logic model on moving from professional development to student achievement, a review of literature provides some guidance in how much influence occurs. For example, researchers from the American Institutes for Research analyzed findings from over 1,300 studies to learn more about how professional development may impact student learning (K. S. Yoon, T. Duncan, S. W.-Y. Lee, B. Scarloss, & K. L. Shapley, 2007). In what may be part of the story itself in terms of research on professional development, only nine studies analyzed met the What Works Clearinghouse evidence standards. However, the nine studies showed a promising connection between substantial teacher professional development and student learning. In their review, professional learning time was a significant variable linking professional learning and increased student learning; teachers who spent an average of 49 hours in professional learning showed a positive impact on student learning (K. S. Yoon et al., 2007). In fact, professional development programs involving more than 14 hours of teacher learning time showed positive impacts on student learning. As important, professional development that only had between 5-14 contact hours showed no statistically significant effects

on student learning (K. S. Yoon et al., 2007).

Professional learning that was sustained and time intensive was also shown by Supovitz, Mayer, and Kahle (2000) to have a positive impact. Their study focused on the National Science Foundation's Project Discovery in Ohio that provided sustained professional development on inquiry based instruction. During this time, teachers spent time learning in an intensive six-week seminar that focused on science or mathematics content. This professional learning continued through a series of six seminars during the school year. Supovitz et al. (2000) found that this professional learning led to a significant increase in the use of inquiry-based instructional practices. This finding was echoed by Corcoran, McVay, and Riordan (2003) in their study of four schools in Pennsylvania and New Jersey that were providing inquiry-based science professional learning. They found that teachers who had over 80 hours of professional learning were more likely to use the inquiry-based instruction than those who experienced fewer hours.

Although research has shown that professional learning that is substantial in time can increase teacher knowledge and skill, it does not mean that time is the only variable. Kennedy's (1998) review of research on professional learning found that contact hours did not impact the outcomes of the professional learning experiences. However, her work illuminated the importance of understandings that the content and structure of professional learning does make a difference. In her review of research, she developed classifications for conceptualizing professional learning:

> 1. *Programs that prescribe a set of teaching behaviors that are expected to apply generically to all school subjects.* These behaviors might result from process-product research or might include things like cooperative grouping. In either case, the methods are expected to be equally effective across school subjects;

2. *Programs that prescribe a set of teaching behaviors that seem generic, but are proffered as applying to one particular school subject, such as mathematics and science.* Though presented in the context of a particular subject, the behaviors themselves have a generic quality to them, in that they are expected to be generally applied across all topics in that subject;

3. *Programs that provide general guidance on both curriculum and pedagogy for teaching a particular subject,* and that justify their recommended practices with references to knowledge about how students learn this subject, and

4. *Programs that provide knowledge about how students learn particular subject matter* but do not provide specific guidance on the practices that should be used to teach that subject (Kennedy, 1998).

She found that studies that fell into categories three and four had a greater impact than professional learning found in categories one and two even though the studies in category one had more contact hours than those in three or four. Based on this, she called for the content of professional learning to be the driving force in developing experiences for teachers rather than the structure of the events (Kennedy, 1998).

In further reviewing the findings of Yoon, et al. (2007), Guskey and Yoon (2009) elaborated on what was learned in their study. Surprisingly, they highlighted inaccuracies many in education hold about effective professional development. For example, the workshop model where teachers learn in a group in a "drive-by" is routinely pointed out as unproductive (Stein, Smith, & Silver, 1999). Yet, while many workshops have been found to be wasteful, all nine studies confirming positive influences of PD on student learning involved short workshops or institutes. Bringing in outside experts is an approach to PD that has lost favor among many educational leaders. Many argue for site-based professional development and should build on

the collective knowledge of staff. However, all nine studies from the Clearinghouse review involved experts from the outside. This echoed the findings from Corcoran, Fuhrman, and Belcher (2001) in their study on district involvement in professional learning. They found that in professional learning designed as site-based, "school staff members paid lip service to the use of research" and "were more interested in designs that drew on research about practices that they already felt were 'good' than in designs that were producing results" (p. 81). In fact, none of the successful professional learning experiences incorporated common forms of site-based professional learning such as train-the-trainer, peer-coaching, and collaborative problem solving (Guskey & Yoon, 2009).

As discussed in the introduction, professional development showed it can be meaningful and support a change in teachers' practice if it is sustained over time, intensive, and purposeful (Garet et al., 2001; Supovitz & Turner, 2000; K. Yoon et al., 2007). Research is clear that by engaging teachers in content specific professional development that is focused on pedagogy can support an increase in teacher skill and knowledge, which may create positive changes in classroom practice; thus, positively affecting student learning.

New Trends

Research on teacher learning communities has developed to emphasize: the organizational conditions needed for teacher communities, different types and frameworks for describing teacher communities, leadership for and of communities, and the influences of communities on teacher and student learning outcomes. Less research investigates how the interactions of formal professional learning and self-directed teams influences teacher's individual and collective learning and practices. But recent research has begun to ask some related questions. Horn (2005) studied mathematics teachers in separate high schools to investigate the ways teachers learn through every day experiences. Rather than focusing her

research on visible teacher communities, she used a community of practice lens to learn more about how everyday interactions contributed to a teacher's learning. She developed a unit of analysis called 'episodes of pedagogical reasoning'. She defined these to be "units of teacher-to-teacher talk where teachers exhibit their reasoning about an issue in their practice" (2005, p. 215). She found that teachers often created norms of sharing and provided windows into their classrooms through "teacher replays and teaching rehearsals" (2005, p. 229). Teacher replays were when teachers reenacted detailed accounts of an actual classroom event; teacher rehearsals were short, practice enactments of an upcoming classroom situation. Both allowed teachers to examine classroom practice and alter pedagogical approaches through situated learning with colleagues. Her work called for future research to identify additional elements of her "conceptual infrastructure" of teacher communities (Horn, 2005).

Furthering Horn's research, Sandra Crespo researched the types of teacher talk that occur in elementary mathematics study groups. She framed her qualitative research by asking, "What do study group conversations reveal about the challenges of and possibilities for enhanced teacher learning about mathematics?" (2006). Her research focused on a single study group of elementary teachers, which she facilitated and was situated among several other study groups at different elementary schools. Drawing from research on the classroom talk by Barnes (1976), Crespo looked at the types of conversations that occurred among teachers and categorized them as "exploratory" and "expository" talk (2006). With exploratory talks, she found that when teachers were doing mathematics in the group, their talk was much more interactive where participants freely interrupted, disagreed, and felt spontaneous. However, when the conversation turned to their own practice and student work, the talk shifted and was more likely to be less interactive and less collaborative, without interruptions among one another. This was termed

expository talk. Crespo concluded that "expository talk is insufficient to help teacher groups become a learning community, one that helps group members re-think and revise their ideas about issues of practice, such as ways of looking at students' work or ways of getting at students' mathematical ideas" (2006, p. 52). Based on her research, she called for further research into the "nature and character of the conversations that happen and could happen" (2006, p. 53).

An important line of work has developed from the efforts of Levine and Marcus (2010) to identify what kinds of teacher community qualities and activities are most likely to improve teacher learning. In their case study, they found that how teacher department meetings were structured and organized influenced teacher learning. They reasoned that a structured teacher community provided for a stronger feedback loop to inform teacher practice. Another critical factor they pointed out was the intended focus of teacher meetings. Teacher groups that focused on classroom instruction provided more learning opportunities than meetings focused on managerial topics. Thus, they argued that if teacher learning about improving instructional practice is an intended outcome of teacher community, than the time organized for meetings should be focused on such. Based on their findings, teachers need to engage in more than just one type of collaborative activity to improve student learning for all students (2010). Their research suggested, "Collaboration which explicitly identifies complimentary means and ends may be more effective" (2010, p. 396). They called for future research that could "link specific kinds of collaborative practice to observable shifts in classroom practice, changes in relationships with students or families, and the ultimate goal of improving student achievement" (2010).

Recent research by Ronfeldt, Farmer, McQueen, and Grissom (2015) has also added new perspective on the influence of teacher collaboration on student learning. Their study, conducted

over two years, involved over 9,000 teachers in the Miami-Dade County public schools. They wanted to move beyond studying collaboration as a school-level event to look at within-school differences in collaboration and the effect on student learning. They looked at the kinds of collaborations occurring within teacher communities and their influence on student learning. Their findings extended those of Levine and Marcus (2010) in suggesting that identifying explicit purposes for collaboration, such as developing pedagogical approaches or developing measures of progress, provide more direction for teacher communities than simply creating teacher teams. They found that collaboration generally led to positive outcomes; however, their findings showed teacher communities that collaborated on assessment had stronger relationships to achievement gains in both mathematics and reading. They argued that the "quality of collaboration about a specific phenomenon to improve performance related to that phenomenon" (Ronfeldt et al., 2015, p. 506).

Theoretical Framework

To conceptualize the interactions of teachers working together I drew on ideas discussed by Horn (2005), Crespo (2006), Levine and Marcus (2010), and (Ronfeldt et al., 2015) and connected them to some of the basic concepts from Wenger's earlier work (1998) on communities of practice (CoP). Wenger theorized that communities of practice developed through the domains of mutual engagement, joint enterprise, and a shared repertoire.

Mutual engagement helps to describe the coherence between people involved in actions that they negotiate with each other. When teachers work together in grade level teams, they work together with one another and not in an abstract environment. In an essence, Wenger argued that "membership in a community of practice is therefore a matter of mutual engagement. This is what defines the community" (1998, p. 73). Furthermore, a community of practice is developed through mutual engagement. Simply being a teacher does not create a community

with other teachers or even teaching the same grade level in a school. Mutual engagement is about the interactions of the community itself. By its nature, the diversity of opinions and ideas of a CoP supports the concept of mutual engagement as individuals come together to bring their views and ideas to life.

The second domain of a CoP is joint enterprise and can be defined as the "result of a collective process of negotiation that reflects the full complexity of mutual engagement" (1998). Here goals and mutual accountability come into play in order to build coherence. Wenger discussed how a CoP would negotiate their response to a situation; thus, creating ownership of their work despite external influences (1998). In schools, self-directed teams working in a CoP are often confronted with curriculum and school level changes outside of their control. The response of self-directed teams to these forces creates a joint enterprise among the team as the negotiate meaning from their response.

The final domain of a CoP is a shared repertoire, which was said to be a build up over time of the joint enterprise, which has created resources for negotiating meaning. Specifically stated:

> The repertoire of a community of practice includes routines, words, tools, ways of doing things, stories, gestures, symbols, genres, actions or concepts that the community has produced or adopted in the course of its existence, and which have become part of its practice (Wenger, 1998, p. 77).

In addition, a shared repertoire includes the "discourse by which members create meaningful statements about the world, as well as the styles by which they express their forms of membership and their identities as members" (Wenger, 1998, p. 77). Understanding these shared interactions can provide insight into a CoP. In 4th grade teacher teams, evidence of the routines and ways of operating might become evident as the shared repertoire of each team becomes reified from this concept to reality.

Wenger (1998, p. 125) also proposed a group of indicators to look for in determining the existence of a CoP. Table 1 illustrates the 14 indicators and how each maps onto the three elements of a CoP.

Table 1.
Indicators for the Presence of Community of Practice and the Proposed Domains

Wenger's indicators	CoP domains
1. Sustained mutual relationships – harmonious or conflictual	Mutual engagement
2. Shared ways of engaging in doing things together	Mutual engagement Joint enterprise
3. The rapid flow of information and propagation of innovation	Mutual engagement
4. Absence of introductory preambles, as if conversations and interactions were merely the continuation of an ongoing process	Mutual engagement Shared repertoire
5. Very quick setup of a problem to be discussed	Mutual engagement Shared repertoire
6. Substantial overlap in participants' descriptions of who belongs	Mutual engagement
7. Knowing what others know, what they can do, and how they can contribute to an enterprise	Mutual engagement Joint enterprise Shared repertoire
8. Mutually defining identities	Mutual engagement
9. The ability to assess the appropriateness of actions and products	Shared repertoire
10. Specific tools, representations, and other artifacts	Shared repertoire
11. Local lore, shared stories, inside jokes, knowing laughter	Shared repertoire
12. Jargon and shortcuts to communication as well as the ease of producing new ones	Shared repertoire Mutual engagement
13. Certain styles recognized as displaying membership	Mutual engagement
14. A shared discourse reflecting a certain perspective on the world	Mutual engagement

In 4th grade teacher teams, the qualities of mutual engagement, joint enterprise, and shared repertoire might develop in present themselves in a number of ways. For example,

mutual engagement in 4th grade teacher teams might develop and present themselves in the nature and quality of relationships among members of the team. The second indicator also provides a possible emergence of seeing if members of the 4th grade team have shared ways of engaging with one another and the work that needs to be done to support their learning. Seeing joint enterprise develop among teams might be evident in seeing whether participants know what others know and can do and how they contribute to their respective 4th grade teacher team. Shared repertoire among 4th grade teacher teams might develop and be evident in the specific tools and artifacts participants bring to the team along with shared stories, inside jokes and inclusion of jargon and communication shortcuts among members of the team.

Connecting these ideas together created a theoretical framework that guided this research study. Figure 2 visualizes relationships among concepts from Ronfeldt, et al., (2015), Horn (2005), and Crespo (2006) to Wenger's (1998) concept of CoP.

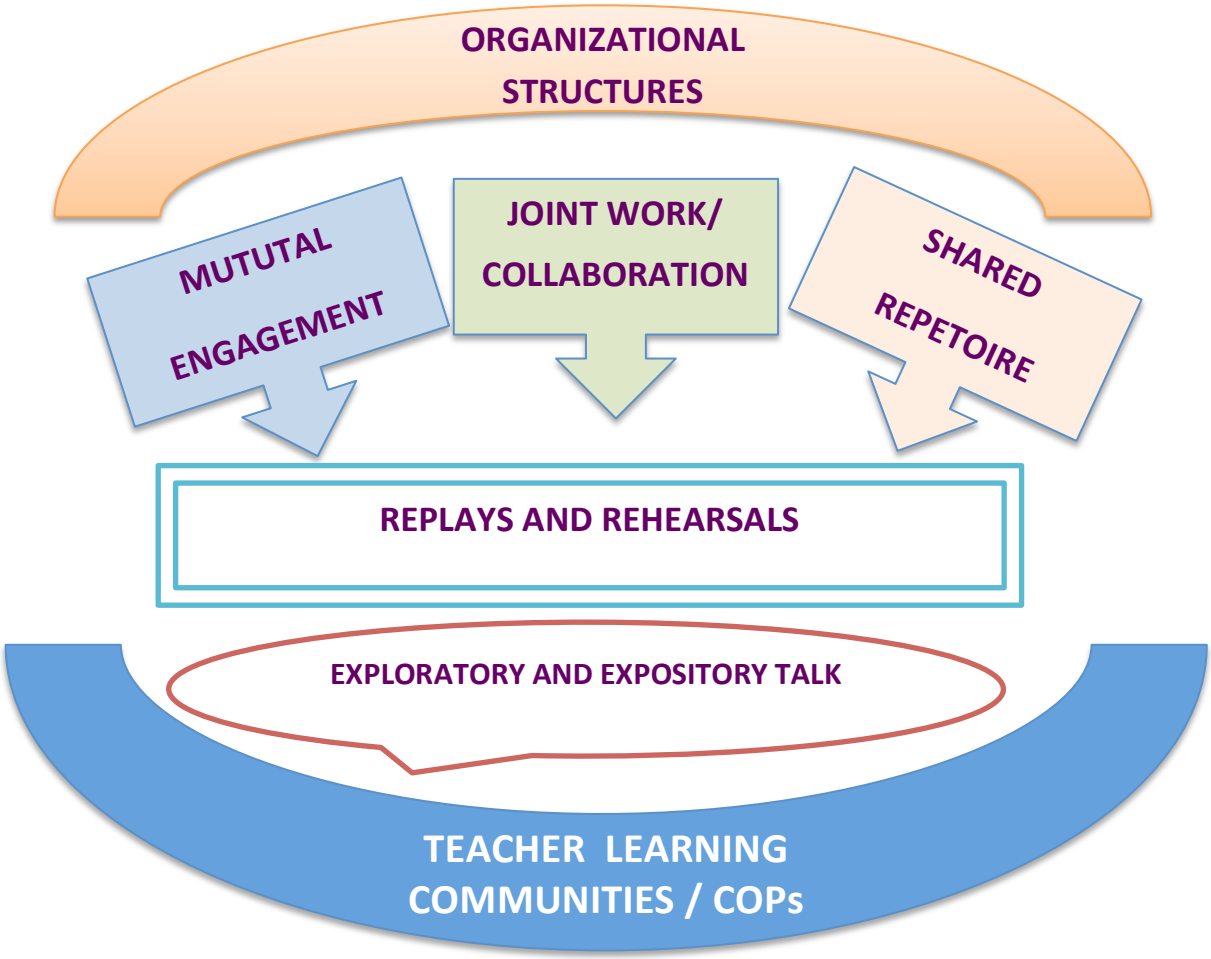

Figure 2. Theoretical framework visualization

In this figure, the domains of a CoP exist within certain structural conditions and initiate forms of work, including collaborative work, that potentially engage teachers in replays and rehearsals, as well as distinct forms of talk. The framework takes the concept of mutual engagement to the research of Ronfeldt, et al. (2015) and Levine and Marcus (2010) through their focus of looking at the types of activities happening within 4th grade teacher teams. As discussed earlier, mutual engagement is about the interactions of the community itself. By looking at the types of activities 4th grade teacher teams are involved in, it might produce a better understanding of their learning.

Joint enterprise speaks to the negotiation of meaning occurring in a CoP as a result of mutual engagement. Horn (2005) recognized pedagogical reasoning as a shared way that teachers open up practices within their classroom. By sharing replays and rehearsals with other members of the self-directed team, shared ways of engaging with one another might emerge. This facet of joint enterprise would further strengthen the work of the self-directed team.

Connecting Crespo's (2006) research speaks to the shared repertoire that might develop in self-directed teams. Focusing on the nature of the conversations that occur within self-directed teams, would give understanding of the shared nature of how teachers interact with one another. Looking for both exploratory and expository types of conversations and linking their occurrences to other facets of a CoP might provide insight into the learning within self-directed teams.

Research Questions

This dissertation began with a discussion of a national movement towards a standards based curriculum with the CCSS. As with any school reform movement, a lot of teacher learning is necessary to enact such reforms. Levine and Marcus (2010) showed in their study of the structure and focus of teachers' collaborative activities that there is a positive benefit for teachers to be engaged in multiple collaborative groups. Horn (2005) recognized the learning of teachers in everyday interactions with colleagues, while Crespo (2006) also recognized the types of conversations occurring within teacher teams may impact teacher learning. Ronfeldt, et al. (2015) showed that a specific focus within a teacher community could significantly impact the effectiveness of the community. The purpose of this research study was to examine the activities of a sample of 4th grade teachers exposed to formal professional development on the CCSS-M and also engaged in more self-directed teacher teams.

Specifically, it sought to understand:

1. How do the activities of a sample of 4th grade teachers engaged in a) formal professional development and b) self-directed teacher teams reflect the activities and qualities research associates with learning and changed practice?

1a. What learning activities do teachers engage in during formal professional development for implementing the Common Core Math Standards and to what extent do these activities reflect recommendations for sustained, intensive, content focused and/or applied PD opportunities?

1b. What learning activities related to CCSS-M do teachers engage in as self-directed teacher teams and to what extent do these activities align with recommendations for specific, detailed sharing and presentation of their instructional practices for mathematics? How well do the activities align with the CCSS-M challenges they are most concerned with? How do teams negotiate individual differences in how they frame challenges, needs and team activity?

2. How do teachers describe the interaction of the formal and informal learning? In what ways did they work in tandem? In what ways did they fail to align? Or create tensions or conflicts?

The implementation of the CCSS-M and adoption of new curriculum materials provided a context for learning how teachers, in this case within a grade level, adopted the reforms specified by the CCSS-M and how they framed issues related to learning and implementation. This

research study furthered the conversation and understanding of how teacher learning in the context of new mathematics reforms were comparatively influenced by the activities of formal professional learning opportunities and self-directed teams.

CHAPTER 3

RESEARCH ORIENTATION AND METHODS

The purpose of my research study was to better understand teacher learning that emerges from formal professional development and from more self-directed teacher learning communities in relationship to implementation of the CCSS-M and new mathematics curriculum materials. How might leaders understand what transpires under different settings and how might richer understandings inform the supports they provide to teachers? My research questions focused on learning more about the activities that teachers engaged in through formal professional development and in self-directed teams. In the following section, I detail the design of my study, sample selection, data collection, data analysis procedures, validity of research, and my own researcher bias.

Design of the Study

I am a practicing principal who lives in the world of teaching and curriculum reform on a daily basis. Denzin and Lincoln (2005) have described qualitative research as a "situated activity that locates the observer in the world" (p. 3). I am in this world and view my research study as a natural extension of my situated nature within schools. Using a qualitative approach, I hoped to "achieve an understanding of how people make sense out of their lives, delineate the process (rather than the outcome or product) of meaning-making, and describe how people interpret what they experience" (Merriam, 2009, p. 14). My research centered on how the learning activities of teachers in formal professional learning and self-directed teams align with current research on professional learning and the ability to make meaning of the CCSS-M. I felt a qualitative approach was necessary to create a thick description necessary for understanding the experiences of teachers in these settings.

Research within the qualitative tradition is often an inductive process where research is conducted to "gather data to build concepts, hypotheses, or theories rather than deductively testing hypothesis as in positivist research" (Merriam, 2009). However, this does not mean the qualitative researcher begins a study with a blank canvas in which to paint a picture. All qualitative research is informed by some theoretical framework that guides and informs inquiry and the interpretation of data (Merriam, 2009). My own research was guided by ideas and theories found from previous studies on teacher community and reforms in mathematics. Deductively, these ideas laid the foundation for my research to discover the experiences of teachers in professional learning and in self-directed teams.

My specific research into 4th grade teachers' learning activities in both formal PD and self-directed teams called for a multi-case study approach. In defining a case study, I used Merriam's (2009) definition that "a case study is an in-depth description and analysis of a bounded system" (p. 40). A bounded system is contained by both time and space and gives clear limits to a case (Creswell, 1998). The case itself is the unit of analysis within a case study approach, not the topic of investigation (Merriam, 2009). If my study was to simply learn how teachers learn in teams, I would not be able to use a case study approach. The unit of analysis would be the teacher's experiences, and a vast number of teachers and their experiences could be used. However, I selected two specific teams of 4th grade teachers within a school district for my research. This created a unit of analysis that is bounded and specific; thus, making a multi-case study applicable for my research. Table 2 summarizes the data collection and analysis strategy used for each of the research questions.

Table 2.

Data Collection and Analysis Summary

Research Question	Data Collection Overview	Data Analysis Overview
1. How do the activities of a sample of 4th grade teachers engaged in a) formal professional development and b) self-directed teacher teams reflect the activities and qualities research associates with learning and changed practice?	Video Observation: 4th grade team meetings Survey: 4th grade teachers Interview: 4th grade teachers, District leaders	Video Observation: coded deductive and inductive analysis (Miles and Huberman, 1994) Survey: Descriptive Statistics Interviews: coded deductive and inductive analysis (Miles and Huberman, 1994)
1a. What learning activities do teachers engage in during formal professional development for implementing the Common Core Math Standards and to what extent do these activities reflect recommendations for sustained, intensive, content focused and/or applied PD opportunities?	Interview: 4th grade teachers, District leaders Survey: 4th grade teachers	Interviews: coded deductive and inductive analysis (Miles and Huberman, 1994) Survey: Descriptive Statistics
1b. What learning activities related to CCSS-M do teachers engage in as self-directed teacher teams and to what extent do these activities align with recommendations for specific, detailed sharing and presentation of their instructional practices for mathematics? How well do the activities align with the CCSS-M challenges they are most concerned with? How do teams negotiate individual differences in how they frame challenges, needs and team activity?	Video Observation: 4th grade team meetings Interview: 4th grade teachers, District leaders Survey: 4th grade teachers	Video Observation: coded deductive and inductive analysis (Miles and Huberman, 1994) Interviews: coded deductive and inductive analysis (Miles and Huberman, 1994) Survey: Descriptive Statistics
2. How do teachers describe the interaction of the formal and informal learning? In what ways did they work in tandem? In what ways did they fail to align? Or create tensions or conflicts?	Interview: 4th grade teachers, District leaders Video Observation: 4th grade team meetings Survey: 4th grade teachers	Interviews: coded deductive and inductive analysis (Miles and Huberman, 1994) Video Observation: coded deductive and inductive analysis (Miles and Huberman, 1994) Survey: Descriptive Statistics

Site Selection

My research questions lent themselves to a case study of teachers exposed to formal professional development and who also participated in self-directed teacher teams. First, it was important to find schools that have formalized efforts to adopt and implement the CCSS-M through the adoption of new curriculum materials (EM4) during the 2015-16 school year. Second, each school needed to have formal PD opportunities that were provided to teachers in

support of implementing the CCSS-M and new curriculum materials. Third, schools should have active teacher teams that are engaged in ongoing collaborative work on the CCSS-M and implementation of new curriculum materials. Lastly, I needed to find multiple sites where I could gain access and have permissions to conduct my research.

While I did not want to study the school I work in, I was inclined to study schools in the district I work in for several, purposeful reasons. Although studying within my own district has characteristics of a convenience sample, it was not the sole basis for selecting to research schools within it. Basing a sample selection solely on convenience would undermine the credibility of my research and would produce "information-poor" cases (Merriam, 2009, p. 79). Therefore, using my selection criteria, I was able to create a purposeful sample that reflected the purpose of this research study.

This school district is a large suburban district located in the Midwest. The district has 17 different schools and has a total of over 10,000 students. Historically, student achievement in the district has been well above state averages on standardized testing. The district is situated in an affluent area and has a strong history of parental involvement within the schools and financial support through the passage of several bonds. Table 3 provides a summary of the school make up within this district while Table 4 provides demographic data of the district.

Table 3.
Summary of District Schools

Grade Configuration	K-4	K-6	5-6	7-8	9-12
# of Schools	6	2	3	3	3

Table 4.
Student Demographic Data

# of Students	White	Asian	Two or More Races	African-American	Hispanic	Economically Disadvantaged	Special Education	English Language Learners
10,131	81.45%	7.25%	4.05%	3.67%	3.31%	9.79%	7.29%	3.55%

The district is led by a superintendent in his 10th year in the district. An Assistant Superintendent of Instruction leads areas of curriculum and instruction. This position is supported by a Director of Instruction who leads a group of Instructional Coaches to support curriculum implementation and teacher professional learning in the district. The instructional coach model was first used in the 2012-13 school year. This model was designed to provide instructional leadership at the building level to both teachers and principals.

Beginning in 2010, teachers in the district were first exposed to professional learning about the CCSS-M. Several teachers were provided formal training at the Intermediate School District under a "train the trainer" model. Many of these staff then provided school-wide professional learning in August of 2010. Pockets of continued learning have occurred within different schools since then.

The district adopted an updated version of Everyday Math in 2012. This updated of version contained minor updates to reflect the new CCSS-M. The updated version contained additional pages that added to the existing curriculum materials. No new professional learning occurred in the district with this update, as it did not contain any major changes.

During the 2014-15 school year, teachers from all K-1st grade classrooms adopted EM4 in support of CCSS-M implementation. EM4 was a major redesign focused on alignment with the CCSS-M and the Standards for Mathematical Practice. For 2015-16, all 2nd - 5th grade teachers implemented EM4 and continued their CCSS-M implementation work that began in 2010. Formal PD occurred in the spring of 2015 and in the fall of 2015.

Historically, the district has done well with mathematics achievement. Figure 3 provides an overview of proficiency on the state standardized test. Assessment data from 2014-15 was not included as a new state assessment was used that year.

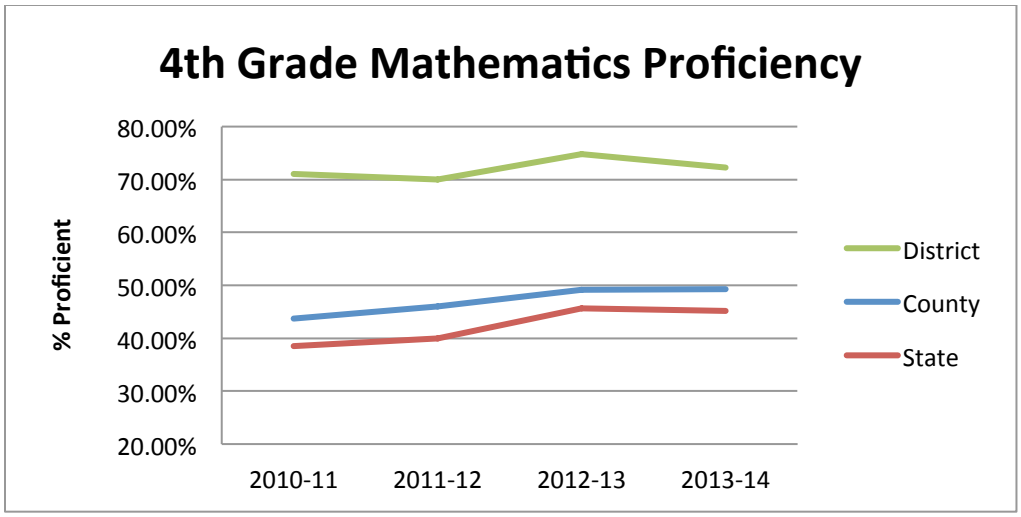

Figure 3. Historical mathematical achievement

Access and permission were greatly eased by my work in the district as a principal. This provided a great deal of contextual knowledge and understanding and enabled access to district leaders who have played a role in in supporting both formal and informal learning in relationship to the CCSS-M and EM4. I speak to the validity issues potentially raised by my insider status later in this proposal.

Teacher Sampling. My target grade level to study was 4th grade. As shown earlier, the district has six K-4th grade schools and two K-6th grade schools. All of these schools implemented EM4 during the 2015-16 school year; it was the first year implementing EM4 for all 4th grade teachers. In addition, 4th grade provided one of the highest numbers of possible research sites.

I was able to recruit two schools in the district that met my purposes. These schools responded to invitations to all school principals in the district that sought schools with 4th grade teams that would:

1. Be comfortable videotaping the times when they are meeting/collaborating
2. Be willing to be interviewed

3. All teach 4th grade math and,
4. Preferably, be teams that have worked together before.

From this invitation, two possible research sites emerged: a K-6 (North Elementary*) and K-4 (South Elementary*) school. Table 5 provides demographic data of each school.

Table 5.
Description of Sample Sites

	North	South
# of Students	668	534
White	86.38%	88.76%
Asian	5.54%	3.18%
African-American	1.20%	3.18%
Two or More Races	3.74%	2.62%
Hispanic	3.14%	2.06%
Economically Disadvantaged	4.94%	10.11%
Special Education	5.69%	7.87%
English Language Learners	1.50%	5.06%

Both schools were organized in self-contained classrooms where each classroom teacher teaches all subjects to students. In addition, both schools had 4th grade teacher teams who were willing to be participants in the study. There were four teachers at North Elementary and five teachers at South Elementary that teach mathematics in the 4th grade. Both teams of 4th grade teachers actively met together to discuss mathematics. At North, the 4th grade teachers met every Monday after school, while the team from South usually met twice a month. Figure 4 provides historical data 4th grade mathematics achievement data on the state standardized test.

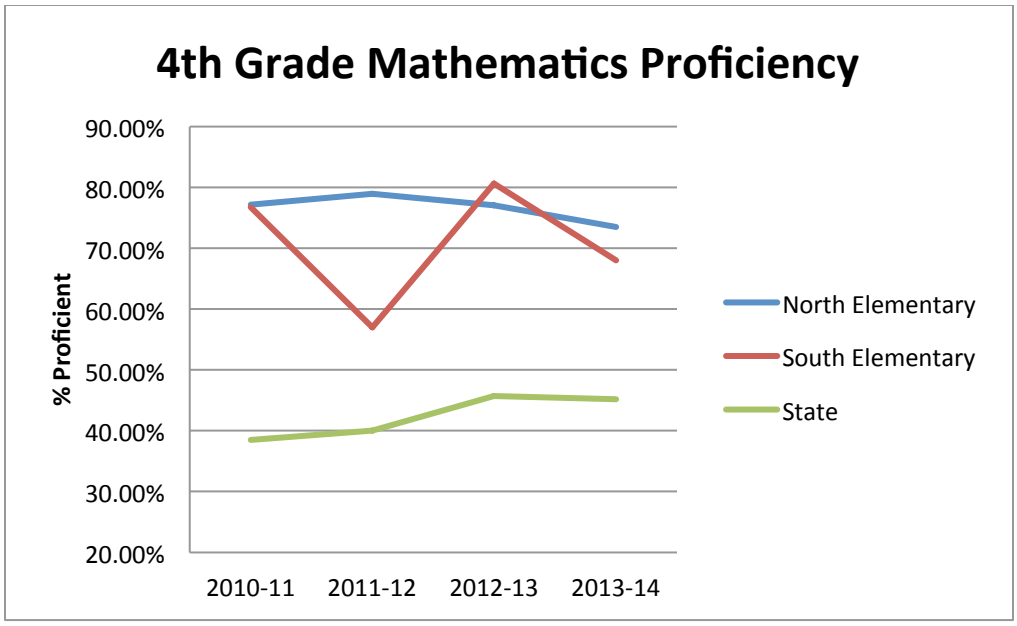

Figure 4. School level 4th grade mathematics achievement

By working closely with individual teachers, my goal was to learn as much as I could about the experience of their work within formal learning opportunities and in self-directed teams. Having individual teachers as a focus allowed me to gain insight into the particular experiences they may have across multiple communities of practice. Table 6 provides a brief summary of the experiences of the participants and their disposition towards math.

Table 6.

Teacher Sample

	Gender	Years Experience	Years in Current Position	Likes Math?
North Teachers (Pseudonyms)				
Norah	Female	18	8	"It's never been my favorite subject to teach."
Elise	Female	19	6	"Math is fun."
Meghan	Female	26	6	"Teaching math for me is probably not my favorite thing."
Sara	Female	39	8	"I'd rather teach other things."
South Teachers (Pseudonyms)				
Nicole	Female	30	21	"Math is fun."
Rachael	Female	12	7	"I absolutely love it."
Wendy	Female	23	4	"I love teaching math."
Reid	Male	12	11	"Math is the most important subject I teach."
Katie	Female	3	1	"I like teaching math."

Data Collection

Survey. My goal for data collection was to develop several streams of data on the formal and self-directed learning activities of teachers, team culture, and their individual and group negotiations of CCSS-M. I administered the survey at the end of data collection so that I could accommodate questions that might be suggested by earlier field work. The survey was given as an anonymous survey to all nine participants. I did not ask participants to identify their school. However, participants may not have felt the survey provided complete anonymity because questions were asked about years in the district and also years of teaching. I used interviews as

an opportunity to remind participants about the survey to encourage participation. All the surveys were completed within 10 days of a request sent via email. One participant had a high percentage of "neither disagree nor agree" responses and did not offer responses on three of the four short responses for reasons that cannot be reliably known.

Interviews. For perspective on district math programs and approaches to professional support and development, I interviewed the District Math Instructional Coach (Appendix C). My selection of this individual stemmed from the transition of this person into her current position. The Math Instructional Coach was a newer position within the district. This position was created in January of 2015 to support teachers across the district with the teaching of mathematics (with a focus on K-8). Before this, the Math Instructional Coach was a 6th grade teacher in the district. She has been a primary point person in providing formal professional learning for both the CCSS-M and EM4 for teachers within the district. Understanding her experiences was valuable in informing how teachers may be framing the challenge of implementing the CCSS-M and how they have been learning about the CCSS-M and EM4.

To understand teacher's views of implementing CCSS-M and EM4, the work and learning activities of their teams and the value and alignment of formal PD to their learning needs, I conducted semi-structured interviews with each teacher participant (Appendix D). Semi-structured interviews are good at capturing the "complex behavior of members of society without imposing any a priori categorization that may limit the field of inquiry" (Fontana & Frey, 2000, p. 653). These semi-structured interviews were used as a culminating experience with participants to deepen my understanding of the perceptions/knowledge of each participant with the CCSS-M, their previous and current learning in formal, collaborative, and individualized experiences, along with an understanding of any learning gaps that existed.

Observations. To investigate informal, self-directed learning activities among teachers, I collected recorded videos of grade level team meetings. In elementary schools, much of self-directed learning resides in grade level teams. The grade level team in an elementary school often gives identity to members within the group as they identify as a "4th grade teacher" and can often influence individual teacher learning and enactments of reform, such as the case with departments within secondary setting (Horn, 2005; McLaughlin & Talbert, 2001). To hear and see what activities teachers select and engage in, and how they interact in team meetings, video recordings of grade level team meetings between January and May were collected from both teams. The number of recorded observations ranged between 6-8. The meetings were videotaped using one stationary camera. The angle on the camera was positioned to be able to see all teacher participants and hear their dialogue. A teacher participant from each school was trained to set up the video camera and record meetings. However, I was able to attend the majority of the team meetings and set up the camera myself while watching the meetings.

Data Analysis

Analysis of Survey Data. The survey data from the teacher participants was analyzed using descriptive statistics for the display of general patterns. This data informed general findings and the narrative of teacher learning developed.

Analysis of Video Data. Video data was analyzed using a set of a priori codes from concepts found in my theoretical framework to capture the activities and conversations that are occurring in team meetings. A deductive approach is appropriate when a researcher "has good prior acquaintance with the setting, had a good bank of applicable, well-delineated concepts, and takes a more explanatory and/or confirmatory stance involving multiple, comparable cases" (Huberman & Miles, 1994, p. 431).

I used the following a priori codes for this purpose:

Level One Codes

- Mathematics discussion (any type of conversation on the teaching of mathematics),
- Management of teaching (discussing report cards and general topics like classroom management),
- Other curriculum area discussion (any type of conversation on the teaching of content except for mathematics),
- Other school related (discussing district directives or school initiatives),
- Personal (narratives of outside events, family) (Appendix E).

These Level One codes were chosen to create basic categorical buckets from topics and activities that normally occur in team meetings. After extracting video segments coded as mathematics discussion I then applied a set of 2nd level codes to identify the types and/or content of the conversations on mathematics. These codes were:

Level Two Codes

- Teacher Replay,
- Teacher Rehearsal,
- Reviewing Student Assessment Data,
- Exploring Curriculum Materials,
- Challenges With Teaching,
- CCSS-M,
- Standards for Mathematical Practice,
- Curriculum Alignment,
- Math Instructional Practices,

- General Instructional Practices (Appendix E).

These codes were selected from research on activities found in teacher teams and also from the literature on professional learning. The validity of these codes is discussed below.

After deductive coding, I used a more inductive approach through the process of memoing. Glaser (1978) described a memo "as the theorizing write-up of ideas about codes and their relationships as they strike the analyst while coding…it can be a sentence, a paragraph or a few pages…it exhausts the analyst's momentary ideation based on data whit perhaps a little conceptual elaboration" (p. 83-84). Memoing can be very important to researchers who begin with a deductive approach to "confront just how adequate the original framework is, and where it needs to be revised" (Miles & Huberman, 1994, p. 74). Analyzing the video data using both coding and memoing allowed me make sense of the types of conversations occurring or the "episodes of pedagogical reasoning" found in the team meetings (Crespo, 2006; Horn, 2005).

Analysis of Interview Data. Interviews were transcribed verbatim. From these transcriptions, I started with coding of the types of learning and activities reported in formal professional learning and in self-directed teams. Examples of these codes are thoughts/experiences formal learning – EM4, other formal learning, Instructional Coach formal learning, Standards for Mathematical Practices, and linking formal learning to self-directed team. Substantive categories were useful in developing a more generalized theory of what is happening within the case study (Maxwell, 2008). This generated categories of the types of activities that occurred within the two settings and how these might connect to learning and enactment of CCSS-M reform and EM4. This analysis assisted in the creation of themes on teacher learning occurring with participants in each community. Through these themes, I was able to provide a

descriptive story of what appeared to transpire among participants in their teacher teams and in their formal PD.

Multi-Case Analysis. Merriam (2009) suggests using a two stage approach with a multi-case study that consists of the within-case analysis and the cross-case analysis where each case is treated as a unique case. I used this approach through the utilization of the analysis procedures described above for each case. The goal of the cross-case analysis was to develop understandings across both cases. Although there were differences in each case, I attempted to create a general explanation that captured each individual case (Yin, 2002). By doing this, the generalizations came from multiple points of data within the cases. The goal with the first look at multi-case data should be "exploratory, to see what the general territory looks like" (Miles and Huberman, 1994, p. 177). My work earlier in analyzing each case through consistent coding helped in developing themes across both cases.

Validity

Miles and Huberman (1994) contended that establishing validity begins with a thorough preparation for the research. I have prepared for this research through my professional life in schools, particularly as a participant and leader of formal and informal learning efforts, and through my graduate studies and thesis reading. I have also brought local knowledge to the study, which has boosted my understanding of these teachers' experiences and observations. I used multiple points of data to triangulate findings from within-case and across-case analysis. Strategies for reducing threats to validity for each data source are noted below:

Interviews. Interviews were transcribed; copies of transcriptions and codes were provided to participants for member checks. This was an opportunity to solicit feedback from participants. Maxwell (2005) described member checks as "the single most important way of ruling out the possibility of misinterpreting the meaning of what participants say and do and the

perspective they have on what is going on, as well as being an important way of identifying your own biases and misunderstanding of what you observed" (p. 111). I believed it was important to share more then just the transcriptions, but also the interpretations that exist in the development of the inductive analysis.

Video Recordings. As the sole coder of the video segments, I do not treat these codes as statistically reliable or validated. Level One codes were quite broad, with face or construct validity that make them arguably credible and trustworthy. Level Two codes were more complicated; at times activity moved quickly or splintered among group participants. Videos were watched multiple times and I have looked for clear evidence in teacher's words to support my coding. More criterion or predictive validity of these codes will require further testing. For the purposes of the study, developing coded data on team meetings was an important step in exploring and describing typically unobserved activity in ways that developed understandings that could inform local practice and that could inform further investigations.

Surveys. Since the multi-case study only had nine teacher participants, I was able to ensure that I had 100% completion of the survey. After the initial survey was sent through email, seven of nine participants completed the survey. A reminder email was sent and the remaining two participants completed the survey with two days. While this small sample cannot represent teachers in the schools or districts, it is fully representative of the sample studied.

Research Bias

With any qualitative study there are threats to validity, often due to researcher bias. Maxwell (2008) defined bias as "ways in which data collection or analysis are distorted by the researcher's theory, values, or preconceptions" (p. 243). My position in this research was that of an administrator and teacher. I was hired right out of college to teach social studies at a large, suburban high school. I taught courses in the social studies department for three years. This first

teaching position did much to shape my beliefs about teaching and learning to teach in schools. For example, departments in this high school had offices where each teacher had a desk. These offices were home base for teachers during their prep period, before and after school, and during lunchtime. Teachers in this high school did not remain in their rooms to work in isolation. There were formal aspects to our working relationships set forth by our administration, for example, designated times to meet with teachers assigned the same class and for the development of common assessments. However, there was a lot of informal interaction as the very nature of being in an office together bred conversations about both work and personal lives. For three years, this was what I saw teaching and schooling to be about. The professional learning developed in these interactions, and not in isolation. These experiences of socially situated learning influence my perspective. From these experiences, a potential bias may be my favorable view of teacher community and its relationship to teacher learning. My professional experiences shape this bias and I continued to be aware of this as I conducted the study.

I have also become a principal and assistant principal since those years. My leadership experiences have presented me with important questions and challenges about how best to support teacher learning. I have observed, for example, that not all teacher teams and interactions result in improved practice. I have seen where outside information and expertise, even outside pressure, have supported and pushed teachers to learn and stretch. I suspect that not every teacher meeting leads teachers to overcome challenges associated with curriculum reform and increased student learning.

Another potential source of bias is that my research was conducted in the district in which I am employed as an administrator. This was a threat to my research and needed to be addressed directly. Internal researchers face bias in terms of pressures to not deliver bad news to

peers or superiors, personal investments in the actions studied, and fear of possible ramifications coming from the study. To combat this potential source of bias, I began by having direct and open talks with the Assistant Superintendent of Instruction about the purpose of my study and her feelings regarding the study. We discussed the need for an open and honest assessment of the case study and she was excited about the learning that would come from it; regardless of whether the findings were positive or negative. I also chose schools with different grade configurations than my own school, which has allowed me to study a grade level not found in my school. By doing this, I hoped to negate the potential for the investment of leadership I have put forth within this district.

The goal of any study is to learn. I felt by studying within my own district, I had an opportunity to not only add to the teacher community conversation, but also to the learning of others in my own district. In the section on validity, I already discussed the idea of member checking throughout the study. Member checking not only supported the validity of my research, but it could also build relationships and trust with my participants. This was important in making any potential bias transparent.

Summary

The goals of this research study were to better understand the activities of a sample of 4th grade teachers engaged in various formal PD experiences and also in self-directed grade level teacher teams. Specifically, I wanted to see if their activities in both settings aligned with research and recommendations for PD and teacher communities. In addition, this research study aimed to see how teachers would describe the interaction of formal PD and self-directed learning opportunities. A multi-case study was used to evaluate these questions across two different schools. In the following chapter, I discuss the findings from this research.

CHAPTER 4

FINDINGS AND OUTCOMES OF RESEARCH

When I began this research study, an overarching interest was to look at the activities of a sample of 4th grade teachers engaged in a) formal professional development and b) self-directed teacher teams. I wanted to examine if the activities and qualities research associated with teacher learning and changed practice were common. More specifically, I wanted to know what learning activities teachers engaged in during formal professional development and to what extent those activities reflected recommendations for sustained, intensive, content focused and/or applied PD opportunities. What learning activities related to CCSS-M do teachers engage in as self-directed teams and to what extent do these activities align with recommendations for specific, detailed sharing and presentation of their instructional practices for mathematics? How well do the activities align with the CCSS-M challenges they are most concerned with? How do teams negotiate individual differences in how they frame challenges, needs and team activity? Lastly, I wanted to know how formal professional development and learning in self-directed teams intersected. In what ways do they work in tandem? In what ways do they fail to align? Or create tensions and conflicts? Using video, interview and survey data, I was able to consider these questions.

A Reflection on My Data Collection Process

The three streams of data for this study were interviews, video observations, and the participant survey. They formed interdependent data for this tale of two experiences at North and South Elementary. Table 7 is a summary of sources of data. As discussed earlier, having three data sources provided an opportunity to triangulate findings from multiple sources.

Table 7.

Data Collection Summary

Data Collection	Data Collection Overview	Generalized Findings
Video recordings of team meetings	North Elementary: 8 meetings typically occurring every Monday after school for 40-50 minutes South Elementary: 6 meetings typically occurring twice a month before school, during lunch, or ½ day meetings	Learned about the activities occurring during team meetings. Allowed for linkages/tensions between formal PD to be observed Supported understanding of formal PD and teacher teams not being dichotomous
Interviews	Conducted towards the end of the school year. Interviews were semi-structured	Used to develop history and understanding of previous formal PD Gained insight into team culture Discovered teacher directed formal PD in the linkage of teacher teams and formal PD
Survey	Given after interviews and video recordings were complete.	Used to learn about impact of formal PD and teacher teams with both the CCSS-M and SMP's Learned more about collaboration and perception of teacher teams

In reflecting on the methods used, it seemed important to share how they impacted findings presented in this chapter. Throughout the course of this research study, I have continued to be a practicing administrator. This full time position did not allow me to immerse myself in the PD activities and all of the team meetings for hours and hours. My choice of methods was also guided by lessons learned from principal colleagues who went before me as Ph.D. researchers. In several cases, their primary method of data collection was interviews and findings were primarily derived from the answers of participants. My driving passion was to know how responses from interviews and surveys might match the day-to-day practices of

teachers. In designing my study, it was really important to find opportunities to see how the reported perceptions and beliefs of teachers might play out in real life. I wanted to have context for the types of learning they described in their interviews and survey responses. Easier and affordable video technologies, as well as video coding software from the College's new Observational Research Lab, made adding video recordings feasible.

Making the decision to video record team meetings was significant to my understanding of the work of the participants. I had envisioned teams setting up video recordings of meetings on their own and sending them to me. The first team meeting took place at North Elementary; I set up the video camera and stayed for the duration of the meeting. I was engrossed and could not find an exit. I was seeing teachers work without having any type of supervisory role for the first time in my administrative career. I ended up staying for the majority of team meetings at both research sites. I simply slid back away from the camera and observed from afar. From seeing the reactions of participants at the end of the first session, I believe both teams forgot about my presence. One teacher from North Elementary commented, "Oh wow, I totally forgot you were taping us." Watching recordings of team meetings when I was present and when I wasn't, I did not see a difference in interactions among participants. Seeing themes they had talked about in interviews play out in real meetings allowed me to make connections I would have missed. For months, I would watch team meeting after team meeting, listening to discussions and watching interactions. Following this, my summer was spent listening to teachers tell their stories through interviews. The time spent with each team and the countless hours watching meetings gave much richer context to the words that came through in their interviews; they became much more than just words. When listening, I could actually visualize the participants, I could see their mannerisms, and I could feel the nuanced emotions in their

responses. I felt it allowed me to really know and make sense of each participant. In all, I believe the decision to watch and listen to the team meetings significantly deepened my understanding of these teachers and their teams. For example, I remember when I interviewed Elise and she was describing some of the characteristics of Norah such as being "a standards person," that I remembered thinking that I had already had discovered that from spending so much time with her the team. Figure 5 provides a reminder of the teacher groups at North and South Elementary.

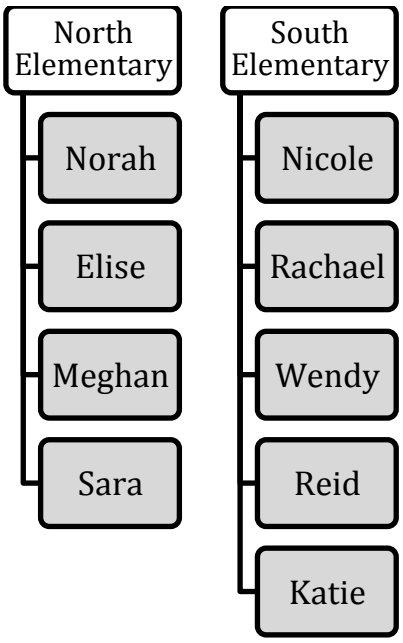

Figure 5. Participants from each school

Through the rest of this chapter, I tell the story of both North and South Elementary in terms of my research questions. I begin by discussing findings from the survey and explain how it became a backdrop to understanding the experiences of these teachers. From there, I share findings on the formal PD experiences of these teachers developed from recorded observations and interviews. I then will explore findings from the data on the activities of teacher teams at

North and South Elementary. To conclude, I will share findings as they relate to how the formal PD experiences intersected with the teacher teams and share two stories from the research to bring to life my findings.

Survey Findings

The main purpose of the survey was to collect background information from teachers on the climate and activities of the teams and their orientations towards math. The small survey sample meant that I looked at all 4th grade teachers as a group rather than as separate teams. I chose not to look at patterns within teams in the survey because I wanted to reduce as much the possibility of identification of the participants. I felt if teachers were grouped by school, they might be less apt to provide answers that were true assessments of their feelings.

Positive Team Cultures. The survey data showed very strong and consistent reporting on the climate of the teams. Eight out of nine participants reported feeling comfortable sharing teaching practices, including strengths and weaknesses, with each other. Six of nine participants agreed or strongly agreed that members of the team observed and provided feedback to one another. Figure 6 display's three climate items suggesting feelings of safety and trust within these groups.

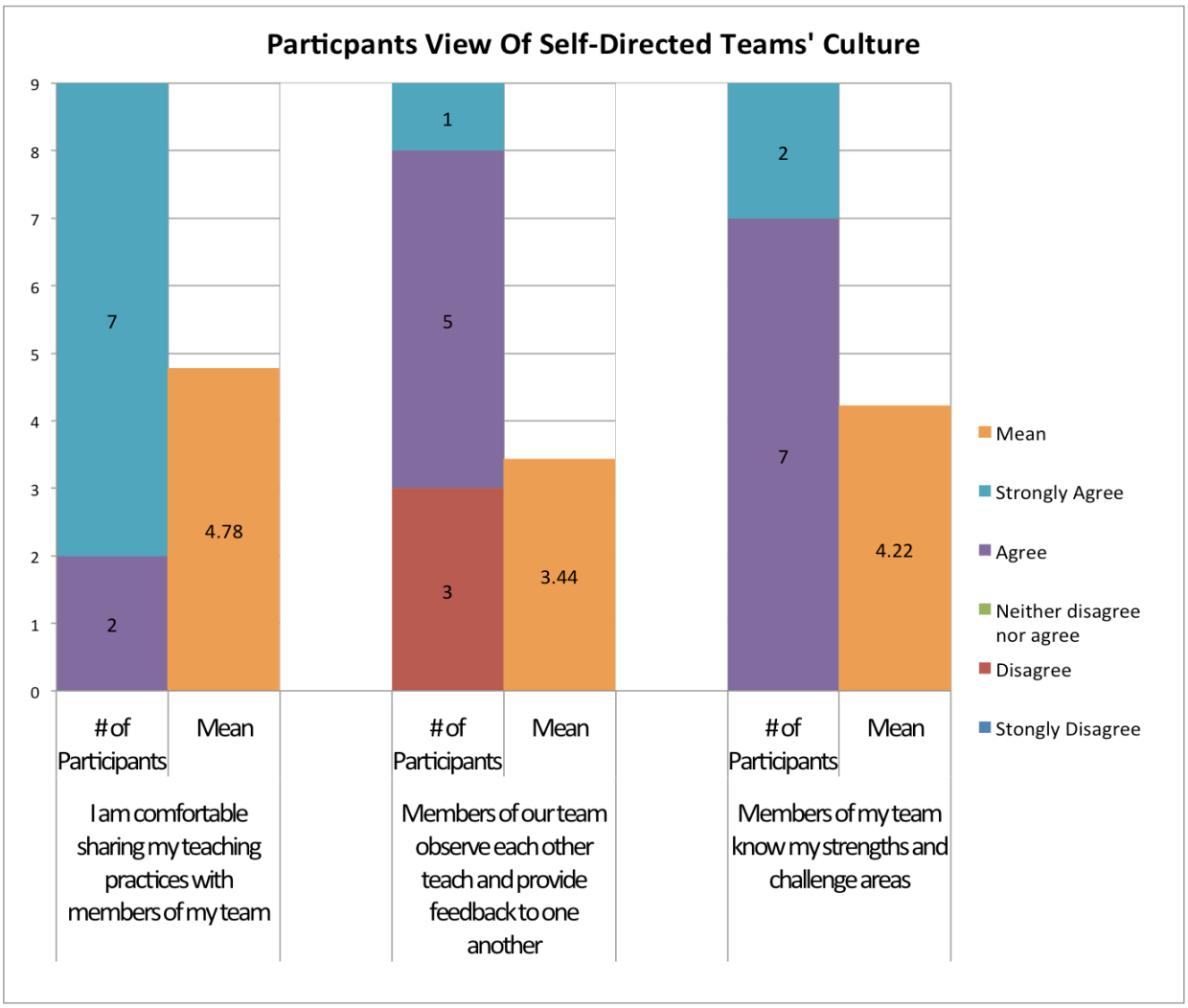

Figure 6. Participants view of self-directed teams' culture

A positive and consistent team culture was also suggested by questions that asked teacher's views on math instruction (see Figure 7). Participants felt that team members engaged in specific conversations about math, and that they shared beliefs about how to teach math, as well as how student learn math.

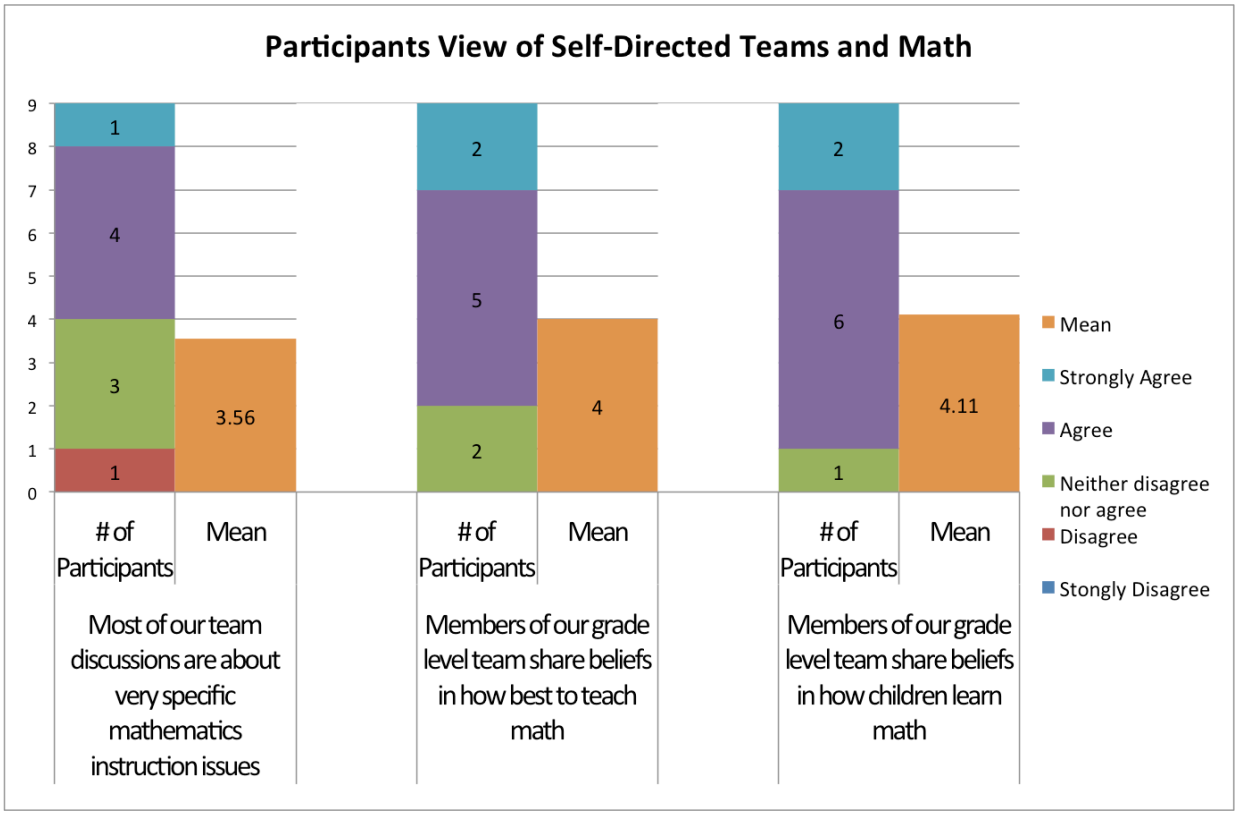

Figure 7. Participants view of self-directed teams and math

Some survey items considered teams through a collaborative lens. It is one thing for a self-directed team to work well together and play nice, but a more important question is the depth of collaborative work among members. For example, for teacher learning to develop, communities of practice (teams) must have strong, collaborative norms, which develop mutual engagement, joint enterprise, and a shared repertoire (Wenger, 1998). Figure 8 speaks to the collaborative culture among the self-directed teams. The overall high agreement with these statements suggest they may function as communities where individual work is transformed through collaborative, joint work with one another.

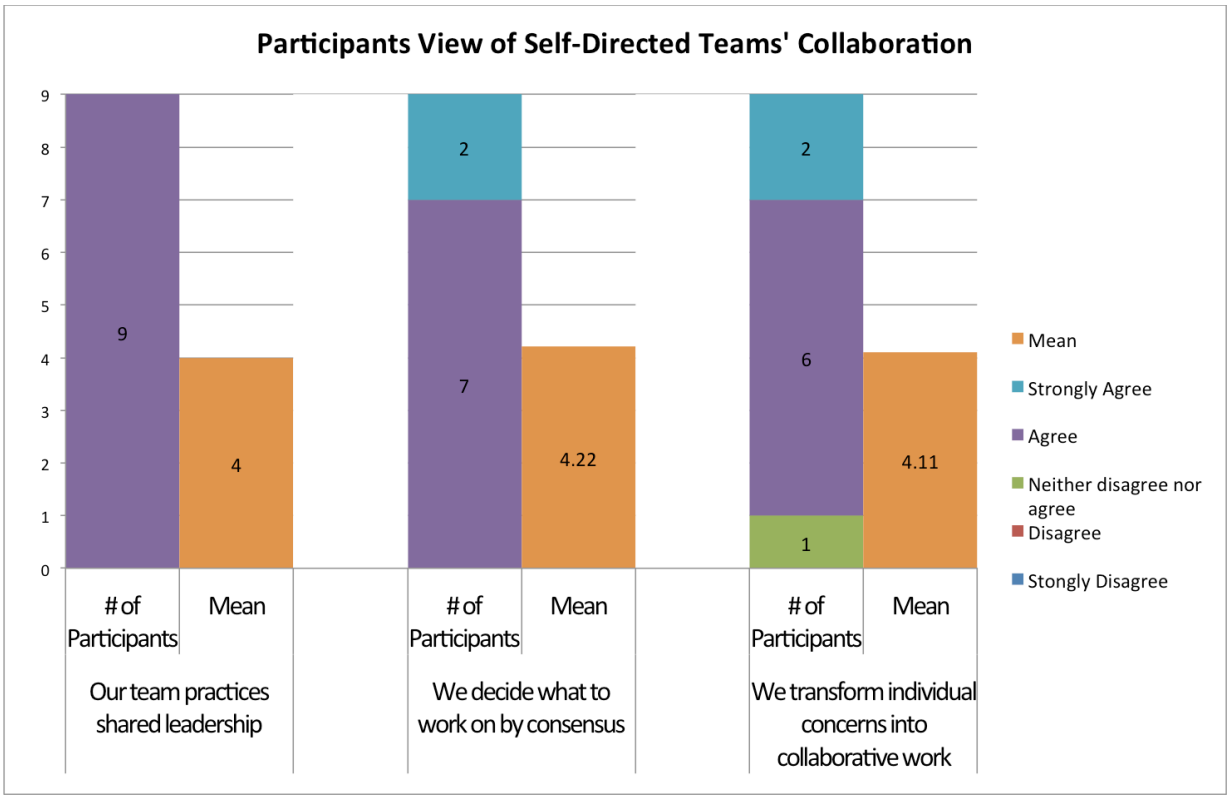

Figure 8. Participants view of self-directed collaboration

Perceptions on Math. Looking at responses to items on math instruction raised a few questions. Since its inception, CCSS-M authors have intended for mathematics instruction to focus on deeper thinking about content and conceptual understanding. Participants agreed that CCSS-M raised the expectations of what students will be learning. Eight of nine participants felt confident that 80% of their students would meet the standards and expectations of the CCSS-M. A majority also felt confident about integrating the Standards for Mathematical Practice into their daily instruction. At the same time, participants reported that it would be helpful to learn more about the Standards for Mathematical Practice. Asked about each standard separately, a majority reported that it would be helpful or extremely helpful to learn more about each of the eight standards. This raised a question of how genuinely confident these teachers felt about teaching CCSS-M and the Standards for Mathematical Practice. Later in the chapter, I will share

more about teachers at both North and South Elementary and their connections with learning about the Standards for Mathematical Practice.

Survey items also asked participants to consider the impact of formal learning (PD) experiences and learning from self-directed teams. These nine questions shed light on how participants felt about each experience, as well as their level of interest to learn more about the Standards for Mathematical Practice through formal PD. Figures 9 and 10 provides a comparison of what teachers felt they learned from formal and from self-directed learning experiences in relationship to the CCSS-M and Standards for Mathematical Practice.

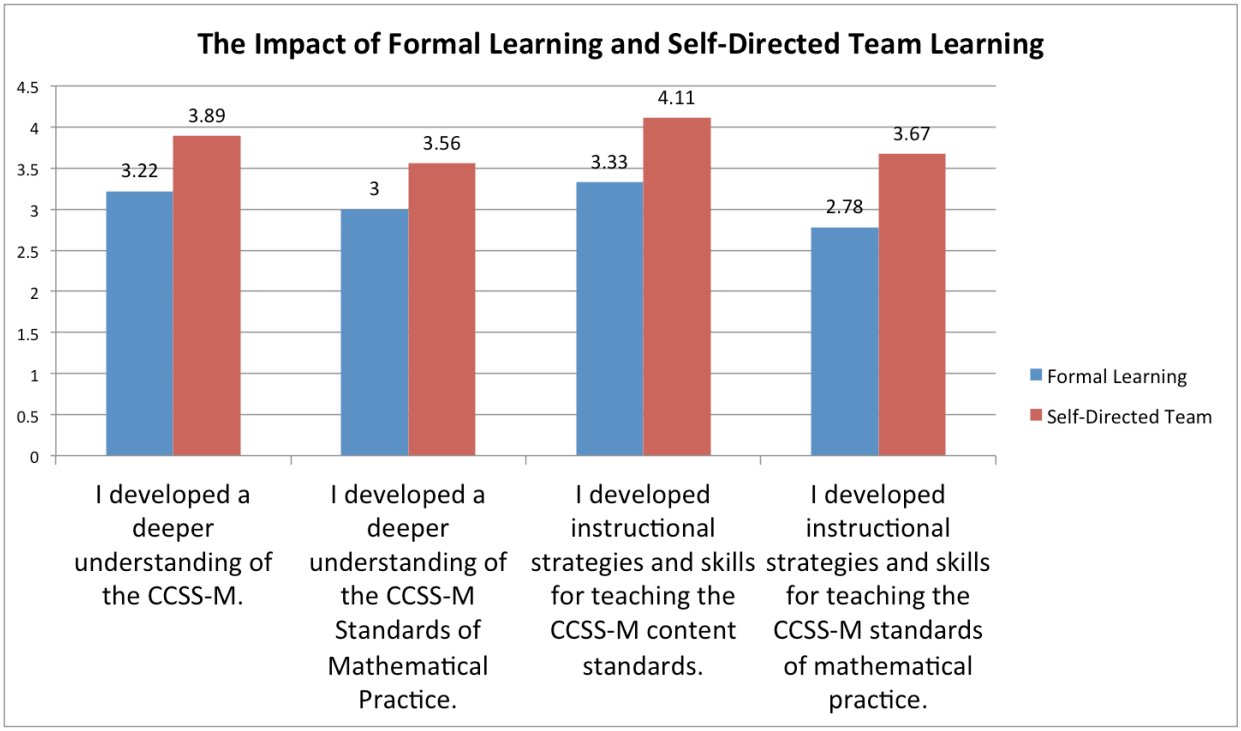

Figure 9. Impact of PD and self-directed teams

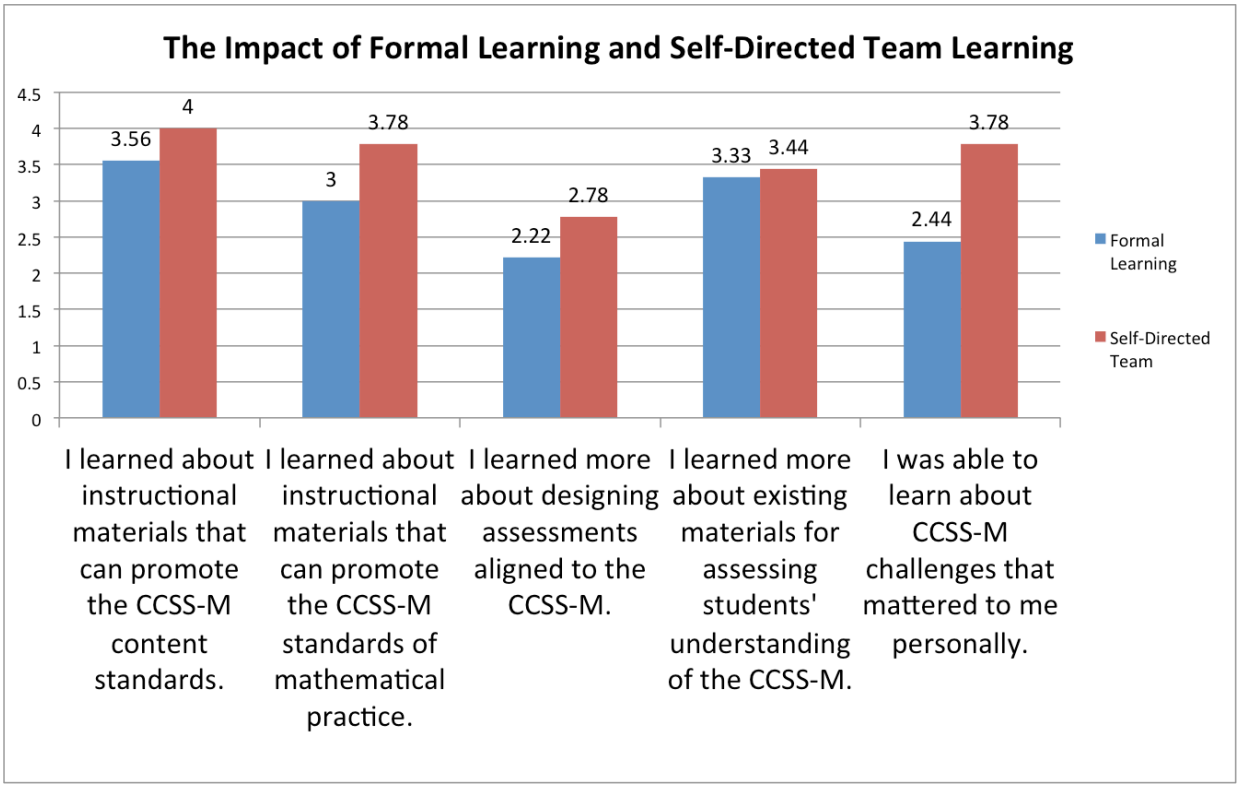

Figure 10. Impact of PD and self-directed teams

Participants consistently agreed that they learned about CCSS-M and the Standards for Mathematical Practice in the context of their teams. In terms of formal PD, only three of the statements drew a majority of agree or strongly agree responses. Two of these focused on the CCSS-M while the third focused on existing materials for assessing understanding of the CCSS-M. In their self-directed team, participants felt strong agreement that learning happened in all categories except for the design of assessments.

The largest discrepancy in reported appreciations between formal PD and self-directed teams concerned the development of instructional strategies for teaching the Standards for Mathematical Practice. It appeared participants did not feel their formal PD prepared them for

developing deeper understanding using the Standards for Mathematical Practice. Figure 11 visualizes this discrepancy.

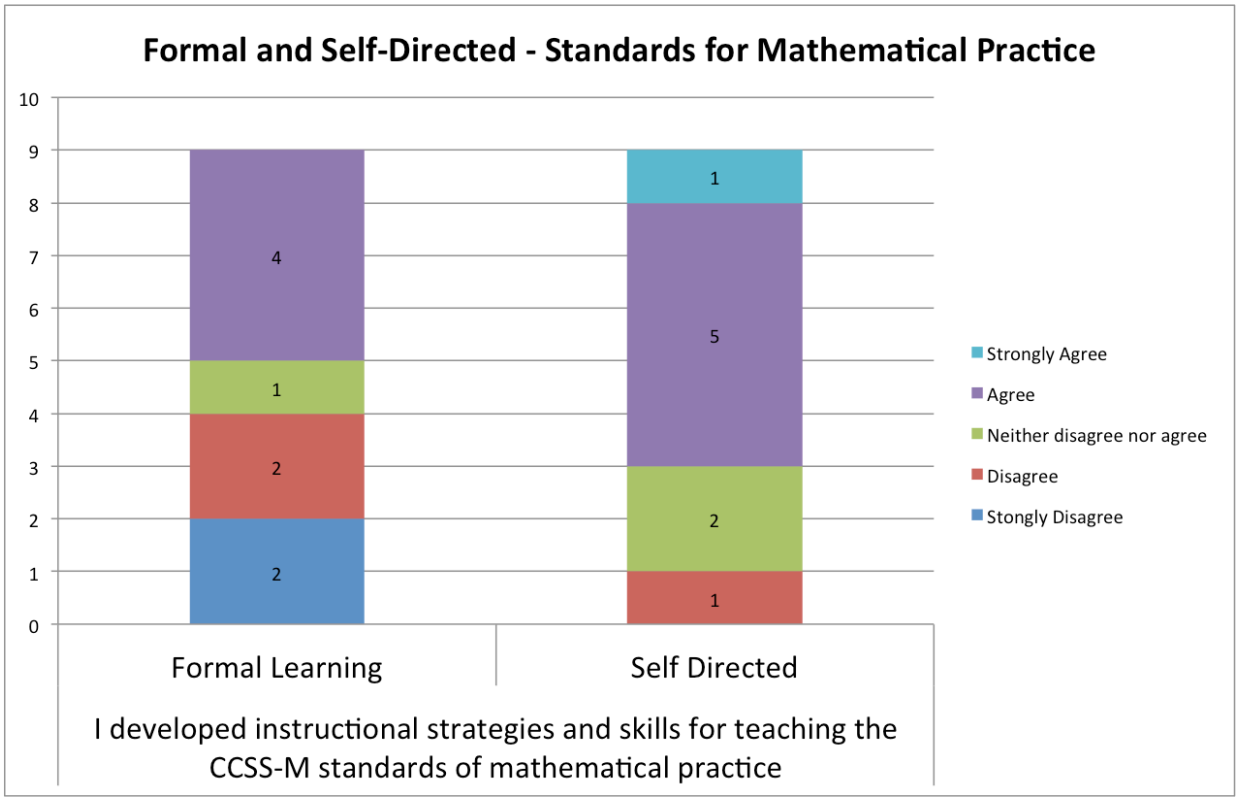

Figure 11. Instructional strategies for standards for mathematical practice across formal learning and self-directed teams

This leads to the last item in Figure 12, which states: "I was able to learn about the CCSS-M challenges that mattered to me personally." Only two participants agreed the formal learning provided opportunities that interested them. In comparison, seven participants agreed that their self-directed teams provided an opportunity to learn about items that mattered to them.

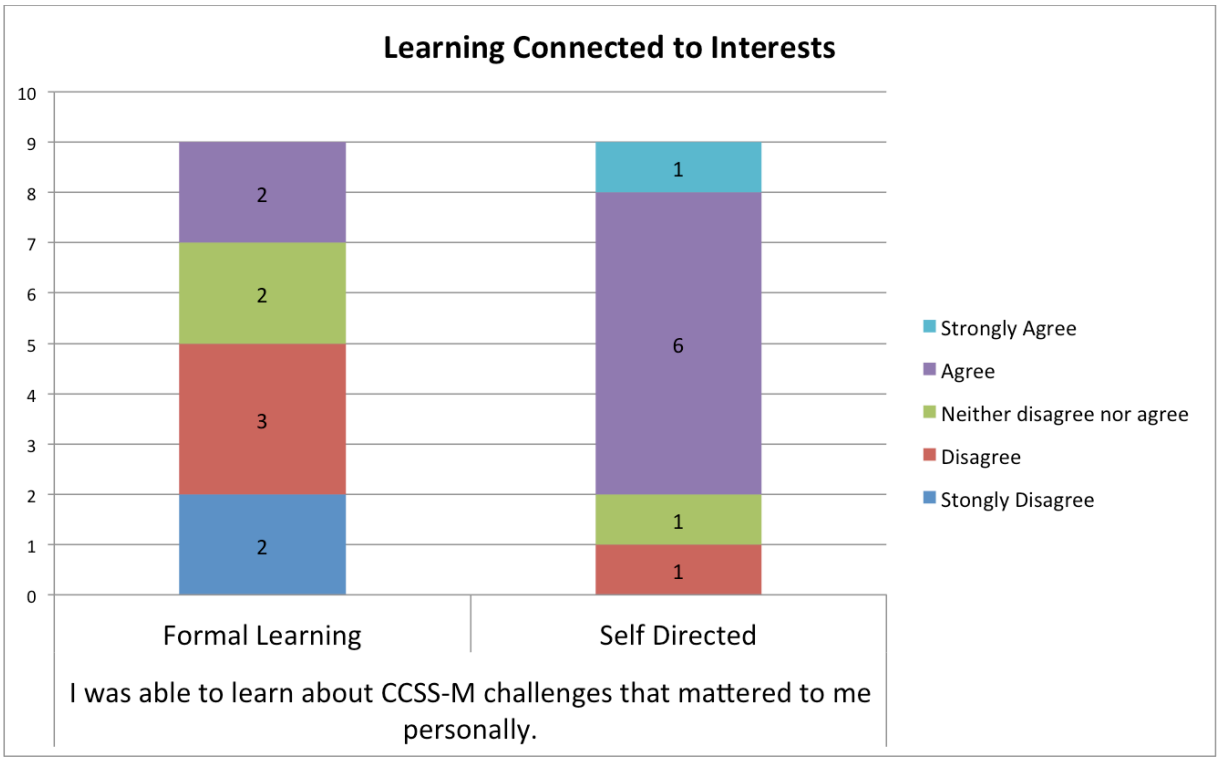

Figure 12. Participants agreement with connection to personal interests

Later in this chapter I will explore this disconnect between reported needs of learning in formal PD and self-directed teams.

The survey posed two open response questions on what participants would like to learn about CCSS-M during the next school year in (1) in the context of formal PD, and (2) their self-directed teams. In their open responses on desires for learning in self-directed teams, half of the participants shared a desire to learn more about the Standards for Mathematical Practice or on topics related to the Standards for Mathematical Practice. Asked what they wanted to learn from formal PD, no one listed the Standards for Mathematical Practice. In fact, only one participant provided a similar learning desire for both self-directed team and formal PD. Every other participant responded with a desire for formal PD that was not connected to their desires for their

self-directed teams. Table 8 displays the participants' responses from directly from the survey on their learning desires from formal PD and in their teams.

Table 8.
Desired Learning in Formal PD and Teams

Participant	Formal PD	Self-Directed Team
Participant 1	It would be nice to learn more about the other resources the program has to offer. I felt like I primarily used the teacher book and student journal this year.	It would be nice to map out what lessons teach the essential learning targets we agree on.
Participant 2	Again, it would be fantastic if School A*, South and School B* teachers could come together and determine the need to knows. This way School C* can count on all kids knowing specific standards.	I would love for my grade level to look at the need to knows! That way we really focus on that.
Participant 3	Ways to teach the writing part.	How to get the precision and accuracy up
Participant 4	more with how to do open responses	How to incorporate mathematical practices more
Participant 5	I would like to take a standard and look at what the expectations are for the 3rd and 5th grade so that I know where they have come from and where they are heading.	I would like to develop a plan to help students master math fact fluency.
Participant 6	nothing	how to incorporate the mathematical practices into my units.
Participant 7	How to make individual formative assessments for differentiation from the curriculum we have.	How the explanations of student reasoning should flow and show student growth in their reasoning over time.
Participant 8	No Answer Provided	No Answer Provided
Participant 9	How to better teach multi step story problems	delve more into the mathematical practices

Short Summary of Survey Data. The survey data indicated that both teams were functional and worked together. They believed their meetings were productive and had positive reactions to their team. Seven of nine participants strongly agreed in reporting they felt comfortable sharing their teaching practices with members of their team. It was clear from this that there was a level of trust at both schools.

The responses on this survey suggest that the aspects of CoP's discussed in my theoretical framework can be found in these two teams. All nine participants either agreed or strongly agreed that the work done by the team is decided through a consensus model. All but one participant believed that their team turned individual concerns into collaborative work within the group. Team members reported a level of functioning that allowed them to develop teaching and learning practices without disruption from a negative culture. Interests and challenges reported were related to substantive instructional matters rather than, say, poorly prepared or committed colleagues, interpersonal dysfunctions or distrust, or badly organized meetings. Despite having characteristics of a CoP, the learning agenda for members of the teams did not appear to be shared. There was a mix of desires for both formal PD and team meetings. Participants may have thought they needed to provide separate responses for each question. Perhaps disconnects between self-directed team and formal PD may be so common that teachers do not link them. Maybe it did not even dawn on them to consider linking the two. I will work to make more sense of the survey data in the context of my research questions.

Teacher Descriptions of Formal Learning

Interviews with the participants asked them to elaborate on their formal PD experiences. For example, participants were asked about the types of formally organized training and professional development for teaching and reaching the CCSS-M and the Standards for Mathematical Practice. Questions also asked them to discuss the formal PD experiences that had

been offered by the district for the implementation of EM4 and what they learned from those experiences. Since I was not able to take part in these formal PD experiences, I relied on interviews to shed light on my first research question that asked about the learning activities teachers engaged in during formal PD and to what extent those activities reflected recommendations for sustained, intensive, content focused and/or applied PD opportunities.

District Wide Professional Development. The district first provided formal PD for EM4 in the spring of 2015 to introduce teachers to new aspects to EM4 such as the open response and engagement lessons found in the new version. This formal PD was designed to take a deep dive into the actual EM4 materials and have all 4th grade teacher teams from across the district complete an open response and engagement, which was a new type of problem in EM4. All 4th grade teacher teams attended the training except for the team from South Elementary. According to the Math Instructional Coach, she "couldn't say it was a requirement because it isn't, the way we do our professional learning. It's very invitational." She stated Wendy from South Elementary came as a "representative" to take notes and share her learning back with the entire group. Wendy was able to recall this training reviewed the new two-day lesson in EM4 but was not able to go into specifics. All four teachers at North Elementary attended the training and were able to recall details of the training such as having to actually complete the two-day open response problem found in EM4. Sara said she liked having to complete the open response because it "was a new type of learning." Other North Elementary teachers echoed these feelings and all of them said this training was more impactful than the formal learning that occurred in August. When asked more about this, they felt that actually getting into the math created more opportunities for learning as the open response was a new part of the curriculum materials for them. They described this as new learning for them, just as it

would be for students, so working through it as a student provided an opportunity to take the perspective of a student they would be teaching.

The teachers of both South and North Elementary were also able to describe a common formal PD experience that took place in the fall of 2015. This formal PD was used to help launch the new EM4 program. According to the District's Math Instructional Coach, the goal of this PD was to familiarize teachers with what was available with the program, how to use it, and what was different. Although the district had been previously using Everyday Math, EM4 was described as an 80% new rewrite of the resources to align better with the CCSS-M. In addition, there was a new online component that was not previously available. The online component was focused on teachers' resources for planning along with resources to support the electronic housing of student documents. Taking place the week before students started school, all 4th grade teachers in the district spent three hours with a trainer from the publisher of EM4 and the district's math instructional coach. Teachers described this formal PD as focused primarily on the online components. For example, Norah stated it "was a lot of just getting on ConnectEd and getting familiar with the online tool more so than in the lessons." Reid mentioned, "One of the EM4 reps was there, kind of going through everything. Kind of pushing the whole online format, using a lot of the e-books." Nicole also responded similarly when she described the formal learning as "basically just learning the online pieces." This formal PD did not appear to support the needs of the participants. In their survey responses, teachers had expressed desires to learn more about topics not covered in this formal PD. In fact, only one participant commented on wanting to learn about additional resources. The other teachers were interested in developing skills related to assessment, supporting students with story problems, and alignment across multiple grades and schools. Rachael reported that it was "very fast paced, quick-moving, just

kind of really looking at how the units have changed. It just seemed like it was more of like a quick little overview of it than, than a real training."

Descriptions provided by the North teachers echoed the sentiments from the teachers from South Elementary. They described this PD as short and focused primarily on the online components of the new EM4 materials. In fact, Sara shared that "there was a lot of stress on getting online and using the online version." However, she then described how this information on using the online program was lost once the school year started as her focus was on the students. From these comments and the interview data, it did not appear the training for the launch of EM4 aligned very well with recommendations for quality professional learning in that it was not ongoing, intensive, or focused on specific instructional strategies.

Other Professional Development Experiences. District professional development on EM4 was not the only formal professional development these teachers engaged in. Some were involved in other programs that could potentially bear on their math instruction. For example, beyond the above, Rachael shared her experience at a training session in Chicago. District teachers were entered into a lottery to "win" a chance to go to the National EM4 Summer Conference in Chicago the summer before the half-day district PD described above. The expectations for this specific PD and for other district PD would be for the participants to come back to their schools and share out the learning from the PD. In fact, the District Math Instructional Coach talked about the application process for this PD included questions designed to insure participants came back and shared. One of the yes/no questions was "I am willing to share out my learnings from the symposium with my grade level during the 2016/2017 school year." Rachael was one of the winners and went to this training. She described how she had the opportunity to sit and talk with the authors of EM4. She remarked how the authors would sit

next to the teachers and go through "a whole unit and what it looked like and showed us the differentiated materials that they had, showing us how the games would work, and talking to us how a lesson should be somewhat structured." She mentioned more than once in her interview how she was able to study the content of EM4 in some depth and also look at sample problems. This formal PD also exposed her to the Standards for Mathematical Practice for the first time. Previously she was unaware of these and how they called for shifts in how teachers teach math. She was excited about how this training supported her to actually work through the math and had time to explore Standards for Mathematical Practice. However, the sharing from this conference never occurred. Rachael even mentioned in her interview about not really sharing about the learning with her colleagues. This will be discussed later in this chapter.

In addition to this formal PD in Chicago, Rachael also served as the gifted and talented cluster teacher in South Elementary's 4th grade. In this district, students who were identified as gifted were cluster scheduled into groups of 4-6. Typically, a teacher at each grade level is designated as the gifted cluster teacher and then received specialized formal PD that provides learning on teaching academically strong students. These formal PD opportunities were led by district instructional coaches and included teachers from different schools and grade levels. According to Rachael, she has been able to use the ongoing PD for the gifted cluster teachers to support math. For example, she mentioned that learning the use of pre-testing has given her an opportunity to "dig deeper" with her students. This digging deeper approach learned was used by Rachael to assess what mathematical skills and conceptual understandings each student had prior to starting a new instructional unit. In fact, Rachael connected her formal PD from the summer EM4 conference to her ongoing formal PD for gifted cluster teachers in using the Standards for Mathematical Practice to support higher levels of thinking. She said that "bringing

in the standards of mathematical practice pushed them even further because they've never really had to explain and be very precise about what it is that they're doing, they're just like oh, well, I got the answer."

Meghan, from North Elementary, also participated in the gifted cluster training. She described the major focus of these trainings as learning to differentiate learning for gifted students in the classroom. When talking about this training, she did not connect it to teaching mathematics in her classroom as Rachael did. Thus, two participants attending the same training on some general instructional practices shared unique takeaways. Rachael and Meghan each have their own unique lens and passions, which they bring to these opportunities. We see them used to support their own interests, Rachael with her love of math and Meghan with her passion for making sure all students are successful.

Elise from North Elementary engaged in formal PD through her involvement in a district supported county-wide Literacy Collaborative. She explained that one teacher from each school in the district was able to be part of this group, which met once per month during the school year with teachers from around the county. She loved having the opportunity to meet new colleagues to collaborate with and having choice in her individual specializations within this training. At one of the trainings on "number talks," she said:

> "The presenter was fabulous and he literally acted out a number talk that you would do in your classroom. It was so cool that teachers who were a part of this group were the students, he was the teacher, and we ran through two or three different ones. It was so cool!"

This PD approach coupled with the ongoing nature of this PD helped to create opportunities for Elise to deepen her knowledge on how to connect these number talks to EM4 and to others on the team. In fact, after the District Math Instructional Coach met with the team on fluency, Elise shared "the book [Number Talks] and then I encouraged others to get the book, too. So after I

had gone, a couple of them got the book and then incorporated and tried to use it along with this program [EM4]."

Summary of Teachers' Formal PD Experiences. There are several findings that emerged when looking at the survey and interview data. Using both sources of data, a disconnect between what formal PD teachers want and what they are receiving was suggested. For example, the interview data from teachers suggested that the formal PD offered in August to launch EM4 was not worthwhile or aligned to their needs. In addition, the absence of all but one teacher from South Elementary at the spring PD indicated that they did not see enough value in the formal PD to want to attend. They simply sent a representative to take notes and bring the information back to the team.

Single Event PD. There were several instances where individual teachers were selected or sent to specialized formal PD. More often than not, these teachers came back with a very positive view of the training and excited about their learning. However, what these teachers felt was a positive formal PD experience is often described by research on PD experiences as not influential to teacher's practice or to student achievement. In fact, the common formal PD experience could also fall into the category. For example, while the August professional learning did incorporate an expert from EM4, staff felt her focus was simply on the arrangement of materials and not on the teaching of math. And, she was not an expert in the curricular and pedagogical shifts required by CCSS-M. These cases of formal PD were limited in time and were not continued beyond these single events. The same holds true for Rachael's experience at the EM4 conference. She was excited and found the experience meaningful for her. However, it was a one-time event and her learning did not make it back to fellow teachers at South Elementary or beyond.

Generalized. Formal learning in the context of training for Gifted and Talented teachers in the study was generalized and not specific to mathematics. This PD seemed to align with Kennedy's (1998) description of PD that focuses on a set of teaching behaviors that are applied to all school subjects, for example cooperative learning. Such PD was not found to be as effective in supporting changes in teaching and learning as opportunities focused on specific pedagogy for specific subjects or understandings on how students learn a particular subject (Kennedy, 1998). The generalized nature of the gifted and talented training allowed individual teachers to apply ideas as they wanted to within their own classrooms. As a result, different interpretations of this formal PD played out at North and South Elementary.

Disconnect in Sharing. When schools send teachers to formal PD, there is often an expectation that they would bring information back to their colleagues to share in either a formal or informal context. Rachael, from South Elementary, even spoke about how they were "pretty good about sharing notes whenever one of us goes to something whether it's during school or out of school." However, there was not a strong indication from the survey or interview data that this was occurring, although it is somewhat assumed by the district.

The one experience that surpassed short, drive-by formal PD was Elise's participation in the county-wide Literacy Collaborative. This PD was ongoing throughout the year and focused on specific strategies for increasing discourse in mathematics using number talks. However, Elise was the lone teacher from North Elementary to attend. She did not have others in the school to collaborate with and share out. Bringing new information to her team and other teachers at North was a simply left to chance. Again, from the interviews, it appeared she worked to share insights on creating opportunities for student discourse in learning mathematics, a practice supported by the Standards for Mathematical Practice. Yet, Elise and her team did not

appear to make that connection despite data from the survey and interviews that showed the Standards for Mathematical Practice were an area of desired learning.

While teachers at both North and South described most of their formal PD experiences as positive, their experiences did not reflect conditions identified by research as more likely to support changes in teacher learning and change in practice. More often than not, the formal PD experience by these participants was short, generalized, and dependent on teachers effectively sharing new knowledge and skills to their team.

The Activities of Self-Directed Teams

The larger purpose of this study was to understand what happens in teacher teams. Specifically, I looked for learning activities related to CCSS-M and the extent to which they aligned with recommendations for specific, detailed sharing and presentation of their instructional practices for mathematics. Did their activities align with the CCSS-M challenges participants were most concerned with? How did teams negotiate individual differences in how they frame challenges, needs and team activity? The survey data suggested that the cultures of the teams were very positive. There were indicators of a collaborative teams in that participants all believed their team knew their strengths and challenge areas in addition to feeling comfortable sharing teaching practices with one another.

I first triangulated data from the recorded observations, interviews, and the survey data to assess the functional norms of these teams. Then, I developed descriptions of each team based on their team meeting and interview data to identify themes from each team related to the study's research questions.

Team North. In interviews, three of the North teachers talked about wanting to be a teacher from the time they were kids. A theme from all of the teachers was how important relationships were in their teaching. Elise commented, "we're a little community in here and it's

important for the kids to feel like they're a part of a team, part of a family." But, interestingly, three of the North teachers also shared that mathematics was not a favorite subject to teach. Two of the teachers recalled not being good at mathematics as a kid and how those struggles affected their desire to teach it. However, this is a group that was very committed to students and places them before subject matter.

It was evident by the natural flow of conversations that teachers felt comfortable with one another. Several times throughout the study, I would hear quick questions about teacher's family members or out of school events. In her interview, Norah, from North, pointed out the close connections within the team at school but outside of school as well. She felt supported in her personal life by her team and noted the longevity of working as a team for seven years as a factor in their comfortableness in sharing teaching practices. In fact, both Norah and Elise talked about how they felt comfortable enough with each other to handle any conflict that may arise. Elise said:

> "I think that one of the things that makes us work so well together though is that we're not all willing to just go with whatever one person says. You know, I think it's okay to discuss. It's okay to question. "Well, wait a minute. Why are you doing that? Or why do you think we need to do this?"

During the team meetings, this comfortableness with handling difference of opinions came through. For example, halfway through the January 4th meeting, Elise shared her feelings that she really wanted to be able to see and know, through worked out problems that her students could do long division. Without hesitation, Norah responded "I don't make them do traditional" sharing her reasoning that she felt some students needed other ways to solve it. Despite this quick rebuttal from Norah, the team was not negatively affected and continued their collaborative meeting without hesitation. Positively negotiating conflict may support and

explain the open nature of team conservations at North Elementary. This open type of conversation was one where teachers would openly question the practices of each other, engage in constant replays of their own practice, inquire about instructional strategies, and share their successes and failures.

While the team meetings at North Elementary tended to be dominated by Norah and Elise, there was a sense of interdependence that came through with this team. This echoed survey data where all nine participants agreed that team members knew their areas of strength and challenges. For example, Elise commented in saying "Norah's big time standards based. Her brain works on that, she knows the standards, very driven in that sense. And honestly, I would say I depend on her for that. I am not a teacher that can memorize the standards, remembers year to year." In fact, there were several times during the eight observations that others also looked to Norah for her information on the CCSS-M. During this study, Meghan would often not speak as much as others. However, she had a self-awareness of this and was comfortable with her role. She commented, "I tend to not speak up as much and that's, I think, due to just different personalities. I might not be able to convey what I want to say about maybe my reasoning why. But yeah, I mean, if I feel like I need my opinion heard, I will definitely express it." During the team meetings, it appeared Meghan felt comfortable taking the lead in replaying classroom episodes that would create opportunities for deeper discussion. At the January 4th meeting, Meghan's replay of classroom practice on how she adjusted the curriculum materials to allow for students to share their thinking led to the first part of the meeting to focus on her teaching.

The team at North Elementary demonstrated norms of trust as evident through their openness and sharing of practices, while also allowing for conflict to occur that did not create insurmountable tension for the group. On the survey, it was clear that they participants felt

comfortable with one another. This was also seen in the back and forth style of conversations during the recorded team meetings. In addition, responses from the interviews showed a sense of trust and commitment to one another. Elise talked about the group not always agreeing, but that "We all at the end kind of come to what, you know, what are we thinking or what's best for kids." Meghan echoed this when she said, "I think people are pretty accepting. I think we all want to help each other and learn form each other." In addition, Norah's leadership was recognized by others and how they looked to her informal leadership. Sara stated, "She's [Norah] kind of the driving force, but we all, I feel like we all have equal say." Having both this strong bond of trust and informal leadership helped this team to function as a learning community.

What North Teachers Did in Team Meetings. The team at North typically met every Monday after school for 40-50 minutes. This was a schedule they developed on their own and were consistent in keeping. Over the course of this research study, I was able to videotape eight meetings. The team did meet an additional two times during this research study that were not recorded. Table 9 displays an overview of each meeting.

Table 9.

North Elementary Meeting Overview

Meeting	Primary Focus
January 4	Discussion of EM4 focused on alignment of lessons and pacing
	Significant focus on teaching multiplication and measuring fluency
January 18	Discussion of multiplication and how to teach it
	Differentiating for advanced students
January 25	Using and sharing additional mathematics resources
February 1	Sharing of student work
February 22	How to measure fluency in multiplication
February 29	Alignment of curriculum topics
	Discussion on assessing fluency for report cards
March 7	Fluency resources from district instructional coach discussed
March 14	Teaching multiple lessons within EM4

From the recorded observations, it was clear that the team meetings at North Elementary were designed to be all encompassing and not just for mathematics. They appeared to address multiple curriculum areas along with grade level and school level topics. In observing each recorded meeting, I documented the time spent on mathematics discussion overall and then analyzed the time spent on more particular mathematics topics to learn what the team did and talked about during their meeting. Across all observed North meetings, the total percentage of team time devoted to mathematics discussion was 47.11%, shown in Figure 13.

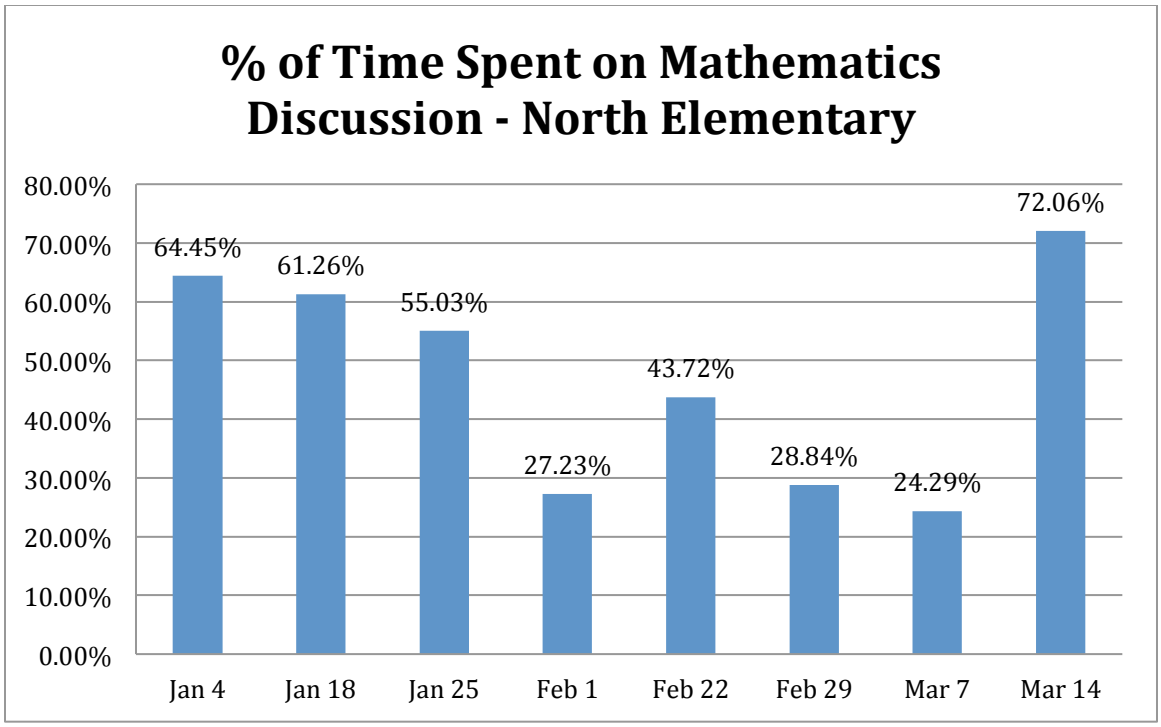

Figure 13. Percentage of time spent on mathematics discussion

North teachers spent a lot of their meeting time discussing math instruction. Even at meetings where time spent on mathematics was below 50%, they began with mathematics discussion before moving to other topics. The team spent higher than average meeting time focused on mathematics in January. Since this was the first year using EM4, much of this conversation in January focused on the pacing of the content and the type of resources found in EM4. The end of the semester in January created a greater focus on EM4 materials and also on fluency because teachers had to report progress on report cards for the first time.

I used 2nd level codes to identify the particular topic or content of the conversations on mathematics (Appendix E). Figure 14 shows the percentages of each code for North Elementary.

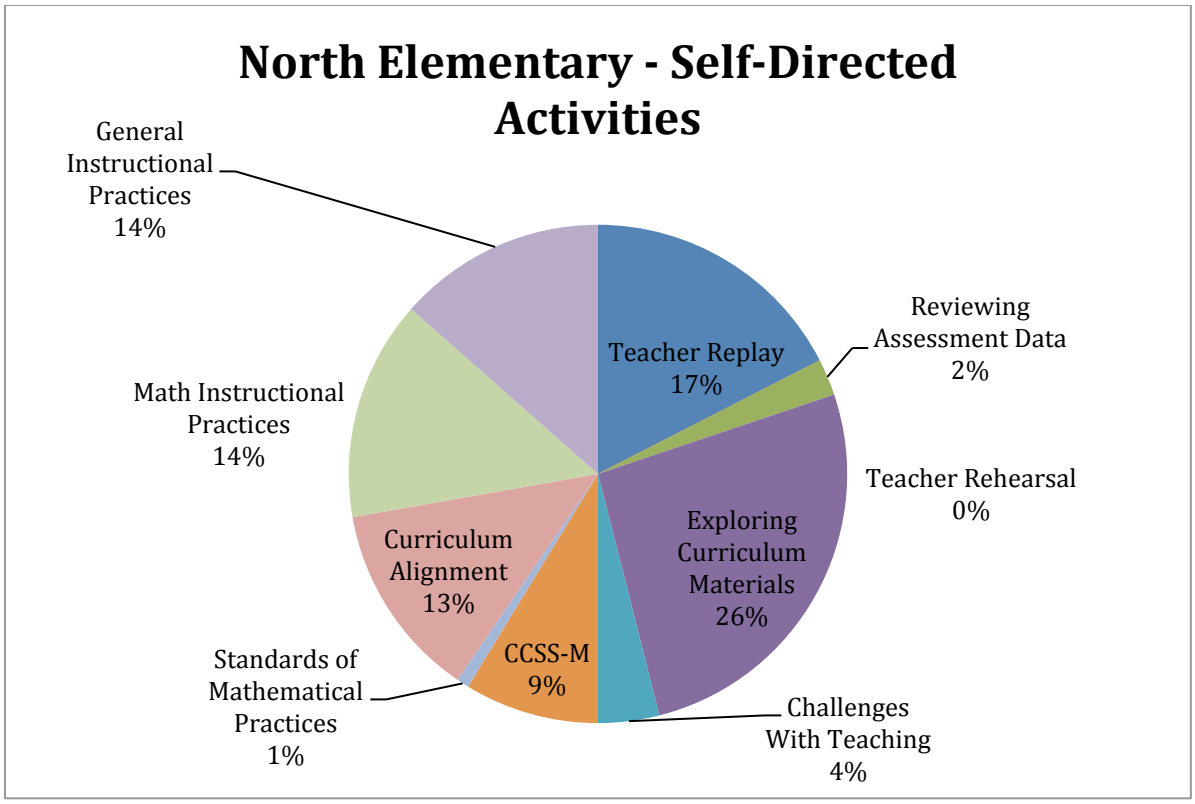

Figure 14. Activities during discussion of mathematics

The team at North Elementary spent the highest percentage of their time reviewing the curriculum materials found within EM4. At most observed meetings, the team would have their EM4 teacher resources with them as a reference. During the time reviewing and exploring EM4, teachers also spent time discussing curriculum alignment with one another. These explorations of resources often created opportunities for teachers to share replays of practice in connection with EM4. For example, at the February 22nd meeting, Sara engaged the team with a detailed discussion of her students struggling with the expectations of the questions in EM4. Sara pulled out her EM4 teacher guide and replayed the struggle of her students with the concept of multi-step problems. However, when exploring resources or replaying their practice, teachers did not often connect their conversations to CCSS-M. Despite new resources being more aligned with

the CCSS-M, teachers did not bring that connection up in their conversation.

Teachers at North Elementary were often interested in hearing more from their team about how they went about teaching both mathematics and other instructional strategies. They spent 14% of their mathematics discussions talking about and sharing instructional practices. These was split evenly between general strategies, such as their schools work at using visible thinking routines across disciplines and specific mathematical instructional strategies using partial products to teach multiplication. Much of their discussion on mathematical instructional strategies connected to supporting fluency in multiplication. This is explored in more detail later in this chapter. Interestingly, despite individual interests to learn more about the Standards for Mathematical Practice reported in both the survey and interviews, there was almost no explicit conversation on the Standards during their team meetings. From the interviews, teachers at North Elementary were clearly aware of the Standards for Mathematical Practice yet never connected their discussions of EM4 or their instructional practices to these Standards.

Replays and Resources. In reviewed literature on teacher learning, one of the ways teachers created norms of sharing and open classrooms was through episodes of pedagogical reasoning (Horn, 2005). These episodes consisted of teacher–to-teacher talk where teachers shared their thinking about an issue or practice. Horn created two categories of pedagogical reasoning: teacher replays and teaching rehearsals. In replays and rehearsals, teachers provided accounts of actual classroom events or provide a place to practice upcoming classroom situations. Horn found that these conversations allowed teachers to examine classroom practice and alter pedagogical approaches through situated learning with colleagues (2005).

A finding from analyzed team meetings at North Elementary is how their exploration of curriculum resources often segued into teacher replays of their practice of this new material. For

example, at the January 18 meeting, Elise was sharing thoughts on how their current unit/lesson provided opportunities for students to talk about the math. She then replayed her experience the day before teaching this lesson. She recalled the types of conversations students were having with the material and the types of questions she was asking them. The team conversations that followed explored this further through multiple back and forth exchanges. Another example occurred within the first three minutes of the January 4th meeting. Sara used a sample problem from EM4 to replay how she had a student use a different strategy to find his answer. She was so involved that she acted out how the student worked through the task. This conversation took the entire group into looking at the EM4 lesson where this teacher replay had occurred. By sharing this teacher replay of a student using a new strategy found in the book, the entire team was involved at looking at the problem and lesson set up in EM4. These conversations differed from what Crespo (2006) found during her study on the nature of teachers discussing and replaying their own practice. In her research, she found teachers used expository, one-sided voice when sharing about their own practice. Here, the group's conversation was situated within discussion of new curricula, not within their own teaching practice. Connecting teacher replay to the investigation of new curriculum materials offered this team an opportunity to deepen their knowledge on both content and practice.

Constructive Conflict. The team's focus on instructional practices related to fluency highlighted this teams ability to manage conflict. The topic of fluency in multiplication carried on throughout the course of this study and will be examined in more detail later in this chapter. Here it offered an example of how bonds of trust may influence conversations and replays. At the March 7th meeting, Norah began by talking about her continued meetings with the district's math instructional coach on assessing fluency. She shared how she was going to partner with

this coach to help assess her students understanding of multiplication using multiple methods including flash cards and simple recognition. She then shared a research article on fluency provided by the District Math Instructional Coach with examples of these flash cards and talked about the specific instructional practices she was using to support fluency. In addition, Norah stated "we should not be using any timed. . . it should not be based on speed" in reference to assessing fluency. What is significant about this interaction is that in earlier meetings where fluency was discussed, it was clear there was disagreement over the assessment of fluency. Members of the team had spent time sharing specific practices for both assessing fluency and supporting students not yet fluent in multiplication. This back and forth allowed for a level of detail on classrooms practices associated with fluency that Kennedy's (1998) research on effective teacher learning speaks to.

It was clear in the January 4th meeting that Norah and Elise did not agree on the assessment and teaching of fluency. Despite this, Norah felt safe at the March 7th meeting to replay what she was doing within her own classroom despite knowing her colleagues had expressed different opinions in earlier meetings. Both Meghan and Elise shared that they were not comfortable with assessing students using non-timed fluency checks. In sharing her thinking, Elise was able to both validate and express differences to Norah's opinion, saying, "I know that's where Lauren [District Math Instructional Coach] is coming from and you are willing to jump on board, but I am not willing to give it all up." While differing in the instructional approaches towards mathematical fluency, the team had open dialogue with a replay making their practices clear.

North Summary. We are reminded through Achinstein's (2002) research that participation in professional learning communities is strongly associated with how these

communities manage differences amidst their collaboration. According to her, "the processes of conflict are critical to understanding what distinguishes a professional learning community that maintains stability and the status quo from a community engaged in ongoing inquiry and change" (2002, p. 446). The team at North Elementary embraced the conflict within the group and used it as opportunities for further inquiry. While the team did not engage in rehearsals of practice, they opened the walls of their classroom through replays of practice and connected their instruction to their new curriculum materials. However, they did not connect this exploration of new materials to the CCSS-M with any consistency and did not engage in some of their own learning interests. They were able to self-direct team activities into activities suggested through research such as focusing on specific instructional practices and continued themes of learning throughout this study.

Team South. During their interviews, all of the participants from South Elementary talked about how well they got along with one another. This corroborated the positive team culture reported on the survey. Rachael summarized this positive team culture by saying:

> "We all teach differently, have different things that we've experienced, things that have gone right, gone wrong. So we do need to use each other, which I think is, at least as 4th grade we're doing with our morning meetings and then our every other month meeting, we're using each other."

Unlike at North Elementary, teaching mathematics was a favorite subject for all five teachers at South. Three of the participants used the word "love" when describing how they felt about teaching. When asked why they loved to teach mathematics, three noted liking the structure found in mathematics. For example, Nicole described math like a puzzle where she gives "kids all these different tools and if they follow the rules, then they can put those pieces together and it all fits." Wendy described her feelings that "there's like a right answer so you can feel like, like you, you know." Paradoxically, one of the motivating factors behind the

CCSS-M is the flexibility found within mathematics and the ability to solve problems in multiple ways.

After interviewing the teachers from South, it became clear that becoming a team comfortable sharing with one another didn't happen overnight. Nicole talked about "getting used to sharing and getting used to each other, it's grown. It was kinda tough in the beginning." Several participants expressed working hard this past year on norms for respecting when others were talking and listening to the ideas being presented. Reid shared that the team had "issues in the past about staff, even in our 4th grade meetings and even at staff meetings, talking over each other." Wendy mentioned becoming more aware of her own talking over others and not always listening. She pointed to the fact that Nicole was an informal team leader who helped keep the team on track. The leadership Nicole provided was mentioned in multiple contexts. Nicole was the person to establish an agenda for meetings, and was also the member that "had to go and have hard conversations with individuals where we have to separate the personal from the work." Rachael also recognized the support she felt within the team when she said, "We listen to each other and we know. I mean, it just kind of comes back to you and if somebody does disagree, they're usually comfortable, then stating their reasons." This was Katie's first year on this team and she also echoed the same feelings. She said, "You feel safe, you feel comfortable. People are respectful of your ideas. So I mean, it's a good group to work with. Very supportive and like I said, being the new teacher, coming in right before school started, I felt like I could go to any of them."

What South Teachers Did in Team Meetings. The team at South Elementary met one to two times per month. Their meetings would sometimes take place before school, during lunch, or on scheduled ½ days of release time. The meetings were often held in the teacher's

lounge, which was in close for all of the 4th grade teachers. This team met for a total of six times during this research study. Table 10 displays an overview of each meeting.

Table 10.
South Elementary Meeting Overview

Meeting	Primary Focus
January 5	Reviewed student assessment data
January 18	Reviewed students assessment data and group students for intervention
February 11	Sharing of math workshop training
March 8	Discussion of additional math resources
April 12	Sharing of district assessment data and how to share it with parents
	Review of student progress in the intervention period
April 14	Review of student progress in the intervention period

Unlike team meetings at North Elementary, South meetings seemed to focus almost entirely on mathematics; 88% of team time during observed meetings was devoted to mathematics discussion. Very rarely did the team delve into other subjects. Figure 15 shows the almost singular focus of South Elementary's team meetings.

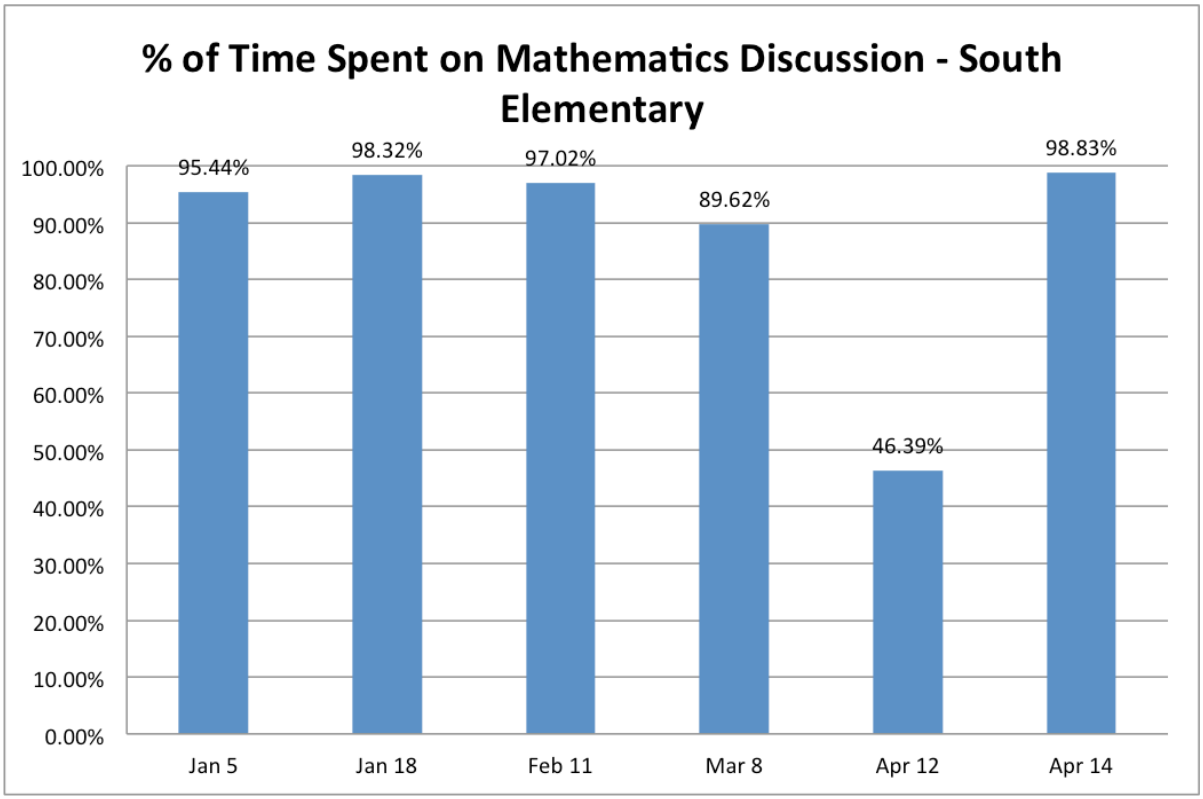

Figure 15. Percentage of time spent on mathematics discussion

It was clear from the first meeting that the main purpose of the team at North was to discuss mathematics and how to support students through the use of assessment data.

I applied the same 2nd level codes used in analyzing the nature of the conversations and activities occurring in regards to mathematics. Figure 16 shares the percentages of time spent in particular math topics across all six meetings.

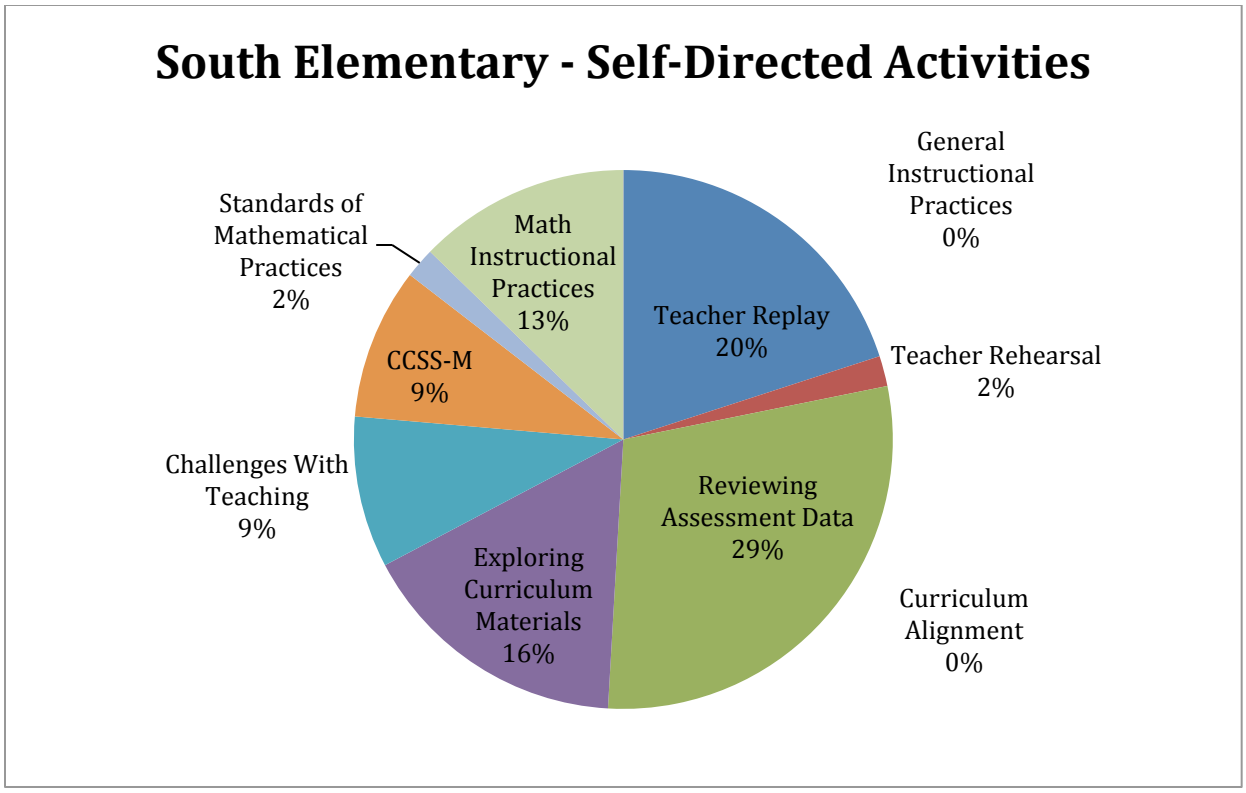

Figure 16. Activities during discussion of mathematics

The team at South spent the largest portion of their time reviewing student assessment data. South Elementary was newly involved in using student assessment data to develop a 15-20 minute morning intervention period in which teachers would ability group students based on math data. Teachers wanted to make sure they did not have their own students during this time. Thus, review of student assessment data dominated team meetings; teachers expressed a lot of excitement about working with student groups from outside their own class. At meetings, teachers often reviewed their assessment data with one another. As an example, at the January 18th meeting, each teacher took 4-6 minutes to review assessment data from their class and to share specific information on how individual students were doing in the current mathematics unit.

Reviewing student assessment data and connecting it to intervention groups became an opportunity for South teachers to replay practices to the rest of the group. These replays accounted for the second highest (28%) teacher activity during team meetings. For example, during the January 18th meeting, teachers took turns sharing what their ability groups were working on during their intervention time. Reid used this time to share about his group working on the concept of perimeter and line segments. He then shifted to replaying the experiences of several students and their inability to add up the numbers to gain the correct the answers. During this replay, Reid was clearly frustrated by his students' inability to add perimeter measurements. At the March 8th meeting, Katie replayed her experience of using games within her intervention group to connect mathematical concepts of regular and irregular shapes. As the intervention period connected teachers to different fourth grade students, their replays served as a progress update on each other's students. Since these replays focused on the mathematics intervention period, discussion of instructional practices were all specific to mathematics and not more general instructional strategies that might apply to mathematics.

Their replays led the team at South to discuss and share curriculum materials that might support their instruction and their intervention groups. But, their discussion of curriculum materials often focused on resources other than EM4. And, unlike at North, it was rare for South teacher to have resources from EM4 with them at their meetings.

Similar to teachers at North, there was little conversation at team meetings about the Standards for Mathematical Practice. Even though Rachael and Katie both reported spending time learning about the Standards and felt they would aid student learning, neither of them brought them up during observed meetings. This also aligned to survey data suggesting a disconnect between formal PD and team directed learning activities.

Consistent Structure. Team meetings at South showed a clear and consistent focus across the study. Teachers came together to review student assessment data and progress and to group students into flexible intervention groups. Levine and Marcus (2010) found that how teacher department meetings were structured and organized could have an impact on teacher learning. They reasoned that structure provided a feedback loop for teachers. In addition, they found that meetings with a specific, intended focus (on non-management items) led to greater teacher learning. Focus helped teams stay on task with the critical learning needs of the group.

The structure found at South Elementary provided a strong feedback loop on working with students during the intervention period. For example, at the January 18th meeting, each teacher took a turn reviewing how their assigned intervention groups were doing. When it was her turn, Nicole used her assessment data to share how her students were doing learning place value. She remarked "I feel like I have had them for just a short time" when talking about frustrations with the "expanded form" terminology being used with the students. When Nicole concluded her turn in sharing, Rachael then provided structured feedback on changes of terminology found in the CCSS-M. The consistency found within South team meeting led to consistent feedback on student assessment data and intervention group progress. Teachers knew the routine from meeting to meeting and were prepared to share updates on student progress in their intervention groups.

Closed Teacher Replays. Another finding that emerged at South Elementary involved the nature of their teacher replays. Much was discussed during the interviews with South Elementary teachers about the growth they have had as a team when it comes to the norms of sharing and collaboration. Teachers had worked to respect the voices of each other and allowed for each voice to be heard. However, after immersing myself at South Elementary through

observations and interviews, the "one person talking" created an atmosphere where questioning, clarifying, and inquiry was not the norm. The teacher replays usually only described a recap of what was done in the small student groups and really did not allow for an opening window into each teacher's classroom. At the April 14th meeting, Wendy replayed a moment in her class where students had to "fill in the hole with 7/12 of a meter and you would have to count." During this interaction and replay, all four other teachers listened but when Wendy was finished, there was a silence among the group. Questions were not asked of Wendy or suggestions provided by other teachers. In fact, there was simply four seconds of silence. When discussion began again, Nicole started talking about something completely separate by asking, "Am I keeping all these guys?" in reference to her intervention group.

When South teachers shared assessment results and their work with intervention groups, they used an expository voice where team members rarely interrupted, asked questions, or dug deeper into the instructional practices described. Sharing involved round-robin reports of assessment results and strategies used, followed by decisions on how to group kids for their next intervention period. This was most evident during the January 18th meeting were teachers appear to "present" their data in turns without interruption and feedback focused on different standards or resources. More developed conversations did not occur in relationship to their own practices.

More often than not, teacher replays occurred without additional interaction. South Elementary's talk turned back and forth dialogue and questioning when the focus of the conversation was a third reference point such as a resource like ScootPad or manipulatives and not on individual practice.

South Summary. The team at South Elementary was one that has evolved over time. In their interviews, they spoke of the work they have put into developing norms to function as a

team. Informal leadership existed at South to focus the group on a consistent structure that routinely focused on student assessment. This line of collaboration is supported by research from Ronfeldt, Farmer, McQueen, and Grissom (2015). They found that collaboration in general led to positive outcomes; however, their findings showed teacher communities that collaborated on assessment were more likely to have achievement gains in both mathematics and reading. It was also clear that this team was still developing an openness of practice. Despite teachers reporting how open they were in sharing practices and ideas, the conversations that centered on individual instructional practice often remained closed. This aligned to research by Crespo (2006) when she found the nature of teacher conversation would more often than not turn to be expository when discussing their own practice.

Old vs. New. My research question on self-directed teams posed questions related to how the activities of teachers relate to the CCSS-M challenges they are most concerned with. I also asked about how teams negotiate individual differences in how the frame these challenges through team activities. A finding related to this research question emerged from looking at a comparison of both schools. The CCSS-M calls for different instructional methods in the Standards for Mathematical Practice that focus on flexibility in solving and working through mathematics. A significant difference that emerged at South Elementary was that little time was spent exploring EM4. Recall the majority of teachers at North Elementary found that teaching mathematics was not a favorite subject to teach. At South Elementary, all of the teachers expressed their enjoyment of teaching mathematics and the "structure" and "rules" associated with it. The new curriculum resource was aligned to the CCSS-M and focused much more on the flexibility in solving mathematics. The CCSS-M calls for different instructional methods in the Standards for Mathematical Practice that focuses on flexibility in solving and working

through mathematics. Maybe the experience at South Elementary is dependent on the lens they bring into teaching mathematics.

As both the teams at North and South Elementary responded to the external influence of new standards and resources, each group spent a significant amount of time relative to other activities engaging in the exploration of curriculum materials. The team at North Elementary routinely explored the new curriculum materials and was active in making sense of them together as a team. Even when sharing specific experiences that replayed their own classroom instruction, the conversation that allowed for questioning, clarifying, and inquiry. On the other hand, exploration of curriculum materials at South Elementary stemmed from conversations of teachers sharing on how they were working with their specific groups of students assigned to them during their intervention period. However, the materials shared and discussed were usually not the EM4 materials, rather they were resources teachers brought from their own experiences. The finding of "old and new" at these schools might best be explained by the research from Coburn (2001) on how teachers negotiate and make sense of policy and curriculum changes. She found that in managing these changes to things such as curriculum, pedagogical practices, and assessment, teachers would tend to turn to their colleagues to make sense of these changes. As teachers from both schools responded to the curriculum changes of both the CCSS-M and EM4, they turned towards each other. The teachers at South Elementary viewed mathematics as structured and fixed while the teachers at North Elementary appeared to not have a strong view of the nature of mathematics since it was not a passion for the majority. As a result, the team at South Elementary worked together through a lens of their previous beliefs on mathematics through team interactions focused on what they already did while the team at North Elementary

was open to a process of learning about the shifts in curriculum and instruction ushered in by the CCSS-M and EM4.

Intersections and Disconnections between Formal and Self-Directed Learning

The third research study question considered how formal PD and self-directed learning might interact. I was particularly interested in finding if these separate experiences worked in tandem to support teacher learning or if they failed to align. In addition, I wanted to see if the interaction of formal PD and self-directed learning caused conflict or tension among teacher teams.

Disconnection with Standards for Mathematical Practice. In the survey, teachers expressed interest in learning more about the Standards for Mathematical Practice in their self-directed teams, but not in formal PD. In observing team meetings I was always waiting to hear how their PD might be discussed. Despite a majority wanting to know more about the Standards for Mathematical Practice, they were never substantively discussed during meetings at North or South.

Rachael shared her experiences at the National EM4 Conference in Chicago, including learning about the Standards for Mathematical Practice. She reported using ideas from the Practices to alter her instruction; it became clear to her that understanding the Standards for Mathematical Practice aided her teaching. However, she did not share this during her team meetings. She talked briefly about the Practices with her team, but she did not get into detail. When asked why she hadn't shared her use of the Practices, she said, "I just don't think maybe it came up. And, I mean, in our talking, it was more, yeah… I don't know, that's a good question. I wasn't trying to hide anything from them. I think because I also had the high group for RTI and [my teammates] were always working on just the basic skills with the kids in, in the other classrooms." This statement would infer that the students working basic skills would not need

instructional approaches aligned to the Standards for Mathematical Practice.

Disconnection also seems evident in interview data from Katie. After observing a 3rd grade mathematics lesson at South Elementary, Katie noticed posters hung that featured the Standards for Mathematical Practice. She contacted the teacher and received copies of the posters, presumably out of interest in them. Wendy remembered an email from the same 3rd grade teacher asking if she wanted the posters illustrating the Standards for Mathematical Practice. She remembered thinking: "Oh, what are those? And then I looked at them and said to Rachael or Nicole, do you guys have those? And then Rachael is like, oh yeah, I've seen those." Despite reported interest in the Practices, connections to Rachael's PD experiences or the posters never emerged and it did not occur to Rachael or to Katie to share their experiences.

Disconnection was also evident at North. Again, despite reporting an interest in learning more about the Standards for Mathematical Practice, they were never really discussed. Norah commented:

> "I don't know that we've really touched on [the Practices] as much as the Standards themselves. I think the perseverance and stamina, when it comes to the story problems, has probably been the one we've really pushed the most. But we haven't really delved into, hey, we're gonna do this practice and this one goes here. We've been concentrating on actually just learning the standards and the new program. So, cuz both of them are pretty, relatively new."

In the face of new learning on EM4, Norah saw the Standards for Mathematical Practice as disconnected from their current learning. For Elise, the Standards for Mathematical Practice were part of a "To Do list". She stated "we were given posters on those and I do not have those and I thought throughout the year, I need to get those up cuz I do have them somewhere but again, that's on my to-do list. Thanks for saying that. I'm gonna add that."

Fluency at North. The disconnection on the Standards for Mathematical Practice is one where teachers' habits and routines did not seem to encourage a connection between formal PD and self-directed learning. The topic of multiplication fluency at North offered a different view of this disconnection, which comes from the diverse beliefs on teaching mathematics and the difficulty in adopting new, but uncertain instructional practices. The team at North was interested in learning more about the multiplication fluency as it relates to the CCSS-M. The team reached out to the District Math Instructional Coach in the fall to set up a formal opportunity to learn more about fluency. A ½ day of formal PD, entitled Developing Fluency and Number Sense was created by the Math Instructional Coach and all members of the team participated. At the formal PD, the District Math Instructional Coach shared a number of research articles and practitioner articles to help define and measure fluency. Previous to this training, teachers at North Elementary used timed assessments to measure multiplication fluency with students. There was a desire among the group to learn different ways to define and assess fluency. Elise recalled "We were wanting to know: how do we go about doing facts testing with the kids, fact check-ins with kids without timed fact tests. Because the research is showing that that's not the best way. And so we stopped doing fact tests come fall and we thought that's not the best way to do it so we're not gonna do it."

Throughout the interviews and in the observed team meetings, it was clear based on the continuous discussion and sometimes disagreement that fluency was an important topic to this team. Coming off the formal PD in the fall, the group reported to be on board with assessing fluency differently. However, Elise described that once it became time to report out to parents on fluency, the team was divided on the direction to take. Meghan summarized this by saying "We just kind of went back to the Everyday Math, the one minute, three minute tests and we did

those as little dipsticks cuz we were like, well, we don't really have anything in place." Along with Meghan, Sara shared her reasons for moving away from alternative assessment of fluency by stating, "Just because we felt that without that focus and the constant repetition, kids were not moving forward with learning their facts. So, we kind of went back to just doing it once a week instead of maybe multiple times a week." Even though Elise thought the strategies presented at this PD were good, she still felt the team had questions. As a result, they "went back to the fact test." This was interesting in that the members of the team enjoyed the formal PD, which integrated self-initiated and formal learning, and felt like they learned, but it wasn't enough for three of the four teachers to change practice.

This formal PD made a lot of sense to Norah and her own instructional practices. She talked about having "a better understanding and the more I understand, the more I would talk to Lauren. Norah continued meeting individually with the District Math Instructional Coach throughout the year to learn more about these questions of fluency. Norah's team knew she was continuing from the formal PD from November. Sara said "I know that Norah continued to meet with Lauren on some, and Lauren worked with some of her kids who were low in learning their facts. And I honestly haven't spoken with her now at the end of the year, which is a conversation I want to have to say so how did that go and could you tell the difference?" Interestingly, the conversation of fluency did come up at multiple meetings during this research study. The following is a short transcription of a segment from the March 7th meeting where the team once again discussed fluency. The tension created from the both the formal team PD and individual PD Norah was engaged in highlights the disconnection between formal PD and self-directed teams when new instructional strategies merge with strong beliefs on instruction. At times

during this segment, Norah refers to "research" that she had been learning about. Despite this, the team continues to push back and reject the notion for changing instructional practice.

> ***Norah****: I talked with Lauren for about an hour this morning. I have eighteen kids who have not mastered their math facts yet. She's going to take them aside and do some different assessments using flash cards and some other things from this article.*
>
> ***Sara****: Can we get a copy of that article?*
>
> ***Norah****: As soon as I have it electronically. One of the things that is coming out is that we shouldn't using any timed and it shouldn't be based on speed.*
>
> *(Elise instantly looks to Sara. Meghan looks at Elise.)*
>
> ***Norah****…we're just trying to figure out another way*
>
> ***Meghan****: Kids are working at getting the number sense but sometimes the memorization was the back up. Kids knowing 8 times 8 is 64 even though they don't know what that means. You're saying that's not good.*
>
> ***Elise****: My thinking is that yes that's where Lauren is coming from. And for you, you're willing to jump on board with that. And honestly right now, I am not willing to give it all up because of the research of one teacher.*
>
> ***Norah****: But it's not one teacher. It's huge research*
>
> ***Elise****: And it's across the district. Even other teachers at this school are not on board yet. And I think it's a disservice to the kids if we don't fully understand it which I think we did in the fall. We were like OK Lauren, we are going to jump on board and do this and then it was like wait, how are we going to do on the report card? We can't change the report card, but yet we have to give the data.*
>
> ***Norah****: And what does that actually mean? That's what we are discussing right now.*
>
> ***Elise****: But we can't change the report card and that's what we have to collect the data.*
>
> ***Norah****: One of our standards is fluency in math facts through 12 times 12*
>
> ***Meghan****: But what does that mean?*

> ***Norah**: Right but that's not speed. We've learned that there's more to it. I have got a ton of kids at 50 using that data. They are not memorizing. So what we're doing from that is figuring out how do we help them learn it.*
>
> ***Elise**: And I get that. It's kind of creating a whole new thing so how will it be done? But I think you've got her helping you with it. I don't think it makes any sense for us all to be like oh, ok we're going to do it too.*
>
> ***Norah**: Oh no, I am not telling you to do it. I am just saying this is what we are finding out. This is the direction we are trying to head. It's just interesting reading this.*

This team meeting illustrated the tension that can come up in teacher teams when members have diverse viewpoints on what they believe is best for their students regarding instructional practice. The team at North Elementary shared a common formal PD experience on a topic they were all interested in learning more about. However, the self-directed formal PD on fluency became a one-time event for three of the four teachers. When their strong beliefs on fluency were challenged, they chose to remain disconnected from their formal PD experience and withdrew ongoing involvement. Only Norah chose to have ongoing PD experiences surrounding this; thus, disconnection occurred among the team throughout this research study.

Workshop at South. A disconnection also occurred at South Elementary in relationship to self-directed formal PD on math workshop. Findings from South showed disconnection that wasn't a result of strong and diverse feelings on mathematics instruction, but one that occurred from different interests with mathematics instruction. Two teachers at South, Rachael and Katie, asked the district for formal PD to learn more about their combined interest in learning how to us math workshop to support EM4. Math workshop is an instructional model that group students, often by ability, to engage with math content through centers. Others in this district had also expressed interest to the Math Instructional Coach about this type of formal PD. The formal PD on math workshop was facilitated by the District Math Instructional Coach. Instead of providing

a stand-alone training, this formal PD was set up as a classroom learning lab where teachers from across the district (including Rachael and Katie) would go into a structured observation of a teacher at another school in the district using math workshop. Time was devoted following the classroom observation to discuss the observation along with resources to support implementing math workshop. Katie remembered going to "watch another teacher at another building because they were using the Everyday Math already and just to see how she took the lesson and made it fit into those different areas." That led to partner planning between Katie and Rachael. Katie was excited about being able to see math workshop in action and talked that it "was huge for us, like oh, we really can make it all work and make it all fit!" Rachael thought learning more about math workshop was beneficial in that "EM4 is set up to really support workshop." Following this formal PD, another teacher at South, Wendy, expressed interests in learning about math workshop and began to collaborate with Rachael and Katie to learn more about math workshop. When asked if the entire team became involved, Katie said "There's another 4th grade teacher and she currently already did her own version of it, so she was good with that and then the only other one, he had something that was working for him, too. So yeah. So the three of us kinda tackled it and yeah, it was good."

Katie continued learning about math workshop on her own. According to her, the principal suggested that she also observe the 3rd grade teacher at South who was doing workshop in a slightly different way. However, when asked about sharing her individual learning with the team, she shared "I didn't really share that out. When we went to the classroom lab, we shared some of what we learned but that was more just like a personal thing**.** I'm sure I could've brought it up, yeah. I guess maybe at the time just being overwhelmed with everything and still being new and surviving to Christmas break."

The majority of the February 11th meeting at South involved Rachael and Katie sharing how they were applying learning from their math workshop PD in their classrooms. Their sharing was trigged by Reid, who expressed an interest in learning what Rachael and Katie were doing to support students with different needs. Rachael and Katie described their use of math workshop in their room. They referred back to the math message, a lesson component in EM4, in how they used that to launch the mini-lesson. Rachael even talked how she "hadn't previously used the math message and just kind've skipped it." However, the math workshop model reportedly deepened her understanding on how to use these curriculum materials. Nicole then shared out on how she had been using her own version of math workshop and "daily 5" lessons with her own class. Wendy asked a lot about managing the classroom with math workshop.

In her interview, Wendy reflected on learning about math workshop from Rachael and Katie and her interest in learning more after it was shared at Meeting 3.

> "I worked with them to try that, which didn't last very, I mean it lasted a couple months but then I went back to the old way, of course. So then I went into their classroom to watch them and it was like oh, yeah, okay, I want to do that, too. So, which I will then try again next year. I think the problem is starting something in February versus the beginning of the year. Might be a little difficult starting something new and a new structure at the same time. Might have been too much."

Neither Reid nor Nicole brought up math workshop in future team meetings or in the interviews. The experience for both Rachael and Katie in selecting their own formal PD experience ended up being a powerful one as they changed their classroom practice to support math workshop. They continued their own learning from this experience planning and sharing together. Wendy tried to join in, but didn't have the formal PD experience to fall back on and reverted to her previous ways of teaching.

Free Agents. The findings from the experiences on fluency at North Elementary and math workshop at South Elementary helped to answer the research question on the intersection between formal PD and the learning that happens in teacher teams. When this research project began, formal PD experiences and self-directed learning in teacher teams was treated as two dichotomies. These were two separate experiences I theorized might link to one another and support increased learning. But what was found might be able to explain a true intersection that creates new opportunities for thinking about teacher learning in schools. At North and South Elementary, both groups engaged in formal PD that was driven organically from their own desires and interests after they were not exposed to formal PD that aligned to their reported learning needs. At North, this experience initially encompassed the entire teacher team. At South, only two members of the teacher team sought out this formal learning experience. This may be why the fluency conversation came up at multiple team meetings at North Elementary, while math workshop only was discussed at one meeting at South Elementary. Either way, at both schools, the teachers that continued this formal PD beyond the initial experience ended up with a greater change in their own practice. This was true of Norah at North Elementary who had on her own continued the formal PD on math fluency and became much more willing to apply this learning to her classroom. Rachael and Katie from South Elementary continued meeting with one another to learn and implement math workshop. Even though Wendy was also really interested in learning and implementing math workshop, her efforts to implement were not successful. This ongoing nature of learning was a requirement of PD to have an impact on teacher practice (Corcoran et al., 2003; Supovitz & Turner, 2000; K. S. Yoon et al., 2007) Based on Katie's comments about the powerful impact of seeing math workshop in action, Wendy's absence contributed to her lack of success with it. A finding found at North and South

Elementary is that when self-directed teams initiate shared formal PD experiences with others on their team and it is ongoing, it leads to an intersection of learning that unites the two dichotomies of formal PD and learning in self-directed teacher teams. However, this also leads the additional finding on the disconnection when teachers see themselves as "free agents" and are allowed the space to develop their own personal interests. Teachers who chose to opt out of continuing self-directed formal PD or those who chose to not go at all, became disconnected from others within the same self-directed team.

Summary of Findings

Through my survey, interviews, and recorded observations, I was able to investigate my research questions by capturing teachers' work in real time at two elementary schools. Using multiple sites allowed me to see how formal PD in a single district aligned to research on effective formal PD. Having both sites provided context as both teams experienced a common formal PD experience. During this time, I saw how both teams engaged in various learning activities during their self-directed teacher teams. While each site was different, there were important findings from both.

The formal PD experiences at both North and South Elementary comprised experiences that did not align to recommendations for professional learning to be sustained, embedded, and specific. Participants in this study seemed to recognize this as well when they responded on the survey and spoke interviews that that learning received from formal PD experiences was not helpful or create opportunities to learn. The formal PD was often seen as invitational by participants and even the District Math Instructional Coach referenced these as sometimes optional experiences. More often than not, the formal PD was a single occurrence without ongoing support or continued learning. As a result, there was a disconnect of sharing by participants. The learning from the formal PD that individual teachers attended did not make it

back to the self-directed teams. Ultimately, this research study found a model of formal PD not aligned to recommendations for teacher learning.

This research study also investigated the learning activities that teachers engage in within their self-directed teams. Specifically, did their activities align to recommendations for specific and detailed sharing of practice? Did they align their work to what they were most concerned about and how did they negotiate individual differences within the team? Team cultures at both schools were positive and teams worked at managing conflict. A finding from both schools showed teachers used replays of their practice throughout the course of this research study. Discussed earlier, teacher replays could be an opportunity to open up the walls of a classroom to deprivatize the work of teaching. However, teacher replays were used differently and led to different outcomes at each school. The team at North Elementary used replays to familiarize and share practices with the new EM4 curriculum resources. Their replays were investigative and offered opportunities for open dialogue. The team at South Elementary also used replays. However, the experience within this team was to replay instructional activities done within intervention groups and was not tied to new EM4 of the CCSS-M. The nature of these replays was often closed, meaning there was little discussion or interaction among participants.

These findings led into another finding within these two groups and that was the learning and unlearning found within both groups. The majority of the team at North Elementary did not "love" teaching math and it was not a favorite subject for them to teach. However, the team at South Elementary all said how much they love math and commented on the structure found within its application. The CCSS-M and the Standards for Mathematical Practice required shifts in how teachers instruct. Focus has been shifted to teach flexibility within mathematics. This research study found that the feelings within a team on what instruction looks like drove their

interactions and sharing of practices and resources. While the team at North Elementary spent time using replays to engage in learning about EM4 and instructional methods, the team at South Elementary was still in the process of unlearning. This focus created experiences where EM4 was not investigated in-depth at their team meetings. Rather replays of practice focused on existing instructional practices.

In addition, this research study investigated the interactions teams made between formal PD and their informal learning within their self-directed team. Did these activities work in tandem or did they fail to align? Was tension created from these separate experiences? A major finding of this research study was the disconnection between the formal PD and self-directed teams. At both schools, there had been interest and even individual formal PD on learning about the Standards for Mathematical Practice. In fact, a majority of participants expressed interest in learning more about them within their self-directed team. However, the learning that occurred on the Standards for Mathematical Practice for some participants at formal PD was never brought back to the entire team despite an interest in learning more about them. Teachers at both schools expressed a need to learn more but these experiences never occurred. There was not a protocol or procedure established to insure learning in formal PD came back to self-directed teams.

Disconnection was also found to occur as a result of individuals on a team having strong and diverse views on instruction or had different interests. The assessment and understanding of fluency at North became a heated topic during this research study and created tension. The entire team took part in a self-directed formal PD on fluency assessment and instruction. However, only one member of the team continued ongoing formal PD experiences. As a result,

her views began to change on instructional practice related to fluency while the rest of the team remained supportive of more traditional ways to assess and understand fluency.

At South Elementary, two members of the team had an interest in learning more about instruction using math workshop. Only these two teachers attended formal PD and continued their learning together during the course of this study. They changed their classroom practice as a result of their experiences with this ongoing formal PD. However, when they shared about their learning with their team, it failed to create instructional changes with the other teachers. This disconnection was a result of different interests among team members leading to limited participation in the self-directed formal PD experiences.

Using the findings from both North and South Elementary, this research study found that there were opportunities for teachers to intersect their learning from formal PD with their self-directed learning experiences. The connection of formal PD and self-directed learning came together when teachers had choice in creating opportunities for their own self-directed formal PD experiences. However, the teachers at both North and South Elementary could be considered to have been "free agents" in terms of learning experiences. The teachers often were left with much autonomy to navigate their formal PD experiences and activities within their self-directed learning. As a result, the intersection of learning between formal PD and self-directed occurred only in pockets and was not systemic.

In the next chapter I will discuss these findings in greater detail. I will also share the implication of these findings through a letter to myself. Even though the letter is written to me, I hope others may be able to apply my findings and learning within their own local situations. Lastly, I will share out suggestions for future research stemming from limitations from this research study.

CHAPTER 5

DISCUSSION AND IMPLICATIONS

This chapter discusses findings as well as implications for school leaders supporting teacher learning and implementation of new curriculum standards. Making sense of the findings of this research study is critical in order to turn towards practical considerations for school leaders. The first part of this chapter identifies and interprets themes as they relate to my research questions. Then, I share implications for school level leaders in the form of a letter to myself. Lastly, I provide a summary of conclusions from this research study.

Interpreting Formal PD Experiences

In this research, I studied the experiences of two 4th grade teacher teams and their participation in formal PD. I wanted to know how their activities aligned to the recommendations found in research for quality formal PD. Even with better understandings of what constitutes more effective formal PD, research suggests a lack of coherent structure for most professional learning and persistence of a "patchwork of opportunities—formal and informal, mandatory and voluntary, serendipitous and planned" (Wilson & Berne, 1999, p. 174). Formal PD activities at both North and South Elementary corroborated many of Wilson and Berne's observations (1999); they often lacked a coherent structure and seemed a patchwork of opportunities that created varied learning experiences for the participants.

Challenge of Diverse Interests and Needs. A difficult endeavor for schools is to match formal PD to the varied needs and interest of teachers. An example from this study was formal PD to introduce 4th grade teams to parts of EM4. All the participants from North made the decision to attend and expressed interest in learning about the new types of math questions used by EM4. Although the entire team from South Elementary was invited to attend, the team chose only to send Wendy. The team saw this PD as optional and felt comfortable in only sending one

member of the team to bring back information. This variance in participation highlighted the challenges of one-size-fits-all models for formal PD and the difficulty of meeting diverse teacher needs. The district could have chosen to require all teachers to attend. However, this may have led to contrived learning that would not have created much positive impact (Hargreaves, 1994).

Liking versus Learning. Often teachers will report liking a formal PD event, thinking it a great experience. However, liking PD does not necessarily mean learning from it and changing one's practice. There were numerous instances during this study were teachers talked about liking the formal PD they attended; participants talked about enjoying their experience. However, the amount of learning reported by participants did not seem very significant.

Another challenge underscored by the study related to sustained formal PD experiences. We know that for PD to make a difference it must be sustained over time. Formal PD experiences that are short lived have been shown to have little to no impact on student achievement (K. Yoon et al., 2007). Throughout this study, there were numerous instances of formal PD organized as a single workshop, where teachers might bring a "drive-by" mentality to learning (Stein et al., 1999). Designing sustained experiences is difficult for districts to develop in terms of financial and human resources. However, there were models in play in the district that showed promise. For example, the county-wide Literacy PD that Elise attended was an ongoing effort that created meaningful learning opportunities for her. Teachers in this study were divided, however, across different short and ongoing formal PD context and were not often engaged in the same PD. When teachers do not participate with colleagues they regularly work with, opportunities for them to make sense of new ideas and practices are limited and they do not share or apply their experiences as often we may want.

Kennedy's research on classifications of professional learning called for the content of professional learning to be the driving force rather than the structure of the events (1998). She suggested that formal PD that focused on generalized instructional strategies did not provide the same level of learning as PD focused on how students learn specific content. This study did not always corroborate this. Meghan and Rachael attended formal PD that focused on general strategies for supporting students in a gifted program. Despite being general in nature, both applied content from that program to their mathematics instruction, though the study cannot judge their outcomes. Whether this research study modifies Kennedy's findings is a question that remains, but the transfer of content from generalized PD to classroom practice reported may simply indicate the importance of multiple approaches to PD.

Assumptions About Spread. Schools often make assumptions that individual teachers share their PD experiences with peers in meaningful ways. Study data surfaced examples of individual teachers going out for PD on their own: Rachael to the EM4 Conference, Elise to the County-Wide Literacy PD, Meghan and Rachael to the Gifted training, etc. The district even went as far as making a commitment to share PD content with peers part of the application process to attend the EM4 National Conference. By requiring teachers to share their PD on the application leaders presumably believed teachers would do so. But there was no evidence that any of the knowledge and skills gained by individuals was shared with others in any planned or significant fashion. It is logical for school leaders to believe this happens. However, research has found that site-based learning based on a train-the-trainer model, where a set of teachers return to train their colleagues, are not successful (Guskey & Yoon, 2009). One can understand the budgetary drive behind this approach, but, without clear supports, strategies, or expectations, the individual formal PD most often remains an isolated experience. Schools will need to be

intentional with creating opportunities for the sharing of learning from individual PD experiences.

Informal Learning and Teacher Learning Communities

A fundamental focus of this research study has been to understand the experiences of teachers in relationship to learning within self-directed teams. My theoretical framework drew on Wenger's concept of CoPs (1998) and the domains of mutual engagement, joint enterprise, and shared repertoire. These domains provided context for ideas shared by Ronfeldt, et al. (2015), Levine and Marcus (2010), Crespo (2006), and Horn (2005) about more and less effective uses of teacher learning time. Spending time with two different teams provided an opportunity to better understand the learning activities teams engage in when facing new curriculum materials and CCSS-M implementation. I was able to consider the alignment of their activities to their interests and how teams negotiated differences in their views on how best to teach math to their students. Connecting data on my study of teachers in self-directed teams to my theoretical framework helped surface other findings and interpretations.

Substantive Use of Support Structures. Historically, the teaching profession has been wrought by isolation; Lortie (1975) described this isolation as the "egg-crate" structures of schools. In this study, I saw clear departures from this, with teachers willingly coming together to engage one another in substantive instructional matters. Working conditions at both schools affirmed research on the importance of structural supports for teacher collaboration and learning. Teams did not have common planning time as called for by Louis, Marks, and Kruse (1996), but their grade level design aligned with findings from Scribner, Cockrell, Cockrell, and Valentine (1999) which argued that grade-level teams share more information and address the interactions of school improvement and grade level instruction. This was evident at both schools as there

were times when teams would be disseminating school initiative information and how it would affect their work.

Also, some have questioned how productive teachers are when given self-directed time for collaboration. Studies of teacher learning communities have found some, which focus on peripheral issues (Hargreaves, 1994; Little, 2003) or student deficits or norms (McLaughlin and Talbert, 2001) of individual choice and variation (Sisken, 2001). This study showed professional use of self-directed learning time to address core teaching and learning issues. This study data suggested investment in teacher time was not wasted.

Professional Norms. Similarly, both teams worked in a dedicated professional manner. Both teams worked to implement the CCSS-M and EM4; though certain norms and experiences looked different. It was clear that team norms and routines influenced what teachers talked about, how they talked, and what they learned. At North, established norms were to be open and to engage in two-way conversation, while at South, agreed upon norms included disciplined sharing in turns to reduce cross talk. South also had routines for consistent data and information sharing process of each team meeting. These norms likely influenced what teachers learned within their self-directed teams. In her research, Coburn (2001), found that in managing changes to curriculum, pedagogical practices or assessment, teachers tended to turn to their colleagues to make sense of these changes. As teachers responded to the curriculum changes of both the CCSS-M and EM4, they turned to each other through established norms and routines of collaboration. The team at North worked at learning collaboratively using replays as the catalyst for sharing. At South, the teacher sharing of their work with flexible student groupings became the conduit for developing their shared repertoire.

Two-way discussions at North raised the question of whether their norms might be the result of their less confident and more exploratory and collaborative orientation towards math and teaching math. In contrast, the team at South felt challenged by EM4 to possibly "unlearn" some of the orientations and structures they loved about math. Remillard and Bryans (2004) found that a teacher's orientation toward a curriculum was something that influenced their engagement with the materials. It would be interesting to study whether the norms of collaboration within teams change when talking about different subject areas.

Leadership. Team leadership also influenced norms and findings from this study align with those from Printy's (2008) research showing the importance and influence of department leaders on teacher learning within a CoP. While neither team at North or South had a formally designated leader each had an informal, agenda setting leader recognized by members. Norah from North and Nicole from South emerged as leaders through their connection to their school's improvement team and their individual initiative. Both leaders helped to define the organizing structure of their work and the development of joint enterprise. Norah from North had a continuous focus on her own continued learning as evident through her ongoing experiences with the District Math Instructional Coach. This openness and desire to learn carried over into the norms of the self-directed team at North in creating an expectation of exploratory conversations based on replays of practice.

Nicole at South was described by her peers and herself as someone who needed to be linear in her work and leadership. During her interview, Nicole described how she had to have conversations with members of the team about staying focused on a topic and not moving to multiple topics because of her needs. She described this as a need for her own ability to learn. Since she was the informal leader of the group, it appeared the shared repertoire at South took on

the needs of Nicole. Conversations and replays were expository and linear with teachers sharing in turns. Rarely did the norms of this group allow for interactive and dynamic conversations.

Learning through Mutual Engagement. Wenger (1998) proposed that particular interactions of a group allow for a sense of mutual engagement to develop; simply meeting together does not create mutual engagement. Indicators of mutual engagement surfaced at both North and South Elementary in how they approached their work in self-directed teams. For example, each site had a "shared discourse reflecting a certain perspective on the world" (Wenger, 1998, p. 125). Teachers at North Elementary had conversation norms that were open and reflective and focused on practice. It was common for different members to bring ideas to the group for discussion and shared meaning making. At South, the team mutually engaged to support students through their assessment and regrouping process. Members took turns giving reports of how students were doing and others replicated this without need for explanation.

Challenges to the development of mutual engagement were reflected in how teachers experienced and shared individual PD experiences. At North Elementary, this challenge manifested through the ongoing discussion of fluency. Norah's individual experience would sometimes override the shared ways of engaging in the work through individually dominated conversation where others could not engage. Similarly, at South Elementary during the February 11th meeting, the individual experiences of Rachael and Katie challenged the agreed upon ways of engaging in group work. During other self-directed meetings, there were distinct ways of working that were shared by all members. However, just like at North, teacher's individual experiences sometimes disrupted the way the group customarily worked with one another, as when Rachael and Katie shared their experience at a math workshop. This change in meeting

structure may be why this type of collaboration only occurred once during the study; the group resumed their shared way of conducting meetings after that February 11th meeting.

Learning through Joint Enterprise. The framework that guided the study looked at joint enterprise in terms of group negotiation of CCSS-M and EM4 demands. The inputs to joint enterprise seemed to differ between the teams. For example, the team at North engaged in learning experiences about the CCSS-M together, for example the optional formal PD on EM4 resources and team initiated collaboration with the District Math Instructional Coach. The desired objective was joint enterprise to make sense of new curriculum, resources, and pedagogy. These efforts, input and outputs if you like, were self-initiated and directed by the team.

At South Elementary, there was more outside influence shaping inputs and outputs. In several interviews, participants spoke about the flexible grouping of students as coming from their principal. Nicole even commented that "Matt [South Principal] didn't ask us to do much so when he does, we feel like we should." There was still sharing but the learning within this self-directed team did not reflect the same degree of self-initiated learning. This difference may be something that needs to be paid attention to by school leaders fostering a school level vision while creating authentic and organic teacher learning in self-directed teams.

Teacher rehearsals and replays proved to be an interesting contribution to joint enterprise, as sharing specific and detailed cases of individual practice with colleagues transformed them into joint endeavor of the group (Crespo, 2006). For example, at North Elementary, teacher replays of specific teaching events seemed an expected and open way of discussing and learning EM4 content and instruction. At South, there was an expectation to come prepared with data and updates as to what one had been doing and its connection to future goals. These replays differed from North in their openness; South teachers still developed joint enterprise through negotiating

the meaning of this data and responses to it. The replays looked different at both North and South, but both affirmed Wenger's (1998) notion that joint enterprise "is not just a stated goal, but creates among participants relations of mutual accountability that become an integral part of the practice." (1998, p. 78). Mutual accountability created through joint enterprise plays a central role in what members of learning community feel concerned about as both individuals and a team.

Learning through Shared Repertoire. Crespo's (2006) concepts of expository and exploratory conversations map well to the concept of shared repertoire and may assist new understandings of the types of interactions that help teachers learn. Indicators of a shared repertoire may manifest in the jargon, shortcuts, shared stories, and representations within the group (Wenger, 1998) and may also, arguably, show up in patterns of expository and exploratory talk. At North Elementary, the content and focus of shared repertoire involved exploratory talk of the experiences found within their classrooms. During their team meetings, shared replays created windows into each other's classrooms and led to open dialogue. Teachers had developed mutual understanding of the nature of their work and of each other. An example of this understanding surfaced in Sara's interview when asked about her 4th grade team.

> "We're a group of four who all want, you know, we're all headed in the same direction. We all want the same thing. We all want to make it work together and so I think there's a lot of great communication. We don't all necessarily agree but we all at the end kind of come to what, you know, what are we thinking or what's best for kids."

At South Elementary, shared repertoire involved more expository talk that supported their norms of sharing. Conversations during team meetings often involved reporting on each teacher's student assessment data. This form of shared repertoire was less exploratory and was careful not to question the practices of team members. While many community of practice

elements were evident at South, newer perspectives might suggest a less powerful or consequential learning environment for these teachers.

Closing Gaps and Thinking in Continuums

When this research project began, formal PD experiences and self-directed learning in teacher teams were treated as two distinct learning experiences. In many respects, the study suggests that leaders and teachers do also. Teachers appeared to learn things at formal PD and then learn separate things in their self-directed teams. This split seemed evident in survey data suggesting that teachers saw their formal PD experiences as separate from work and learning in their self-directed teams. It was also evident following the formal PD on EM4- no substantive follow up discussion and application by team members was observed. It was further evident in the failure of train-the-trainer strategies, and the surprise some teachers expressed when asked to explain why they had not attempted to bring their individual PD experiences into their team's ongoing work. Lastly, from watching team meetings at both schools, and interviewing participants, there appeared to be few habits or mechanisms for coordination and connection among the different learning contexts. Team and school leaders did not actively stimulate or structure connections between formal PD and weekly team meetings and that there were no established routines or protocols for doing so.

Some of this may reflect positive habits of focus on the part of teams, and the reality that their time is routinely spent collaborating on current instructional units and lessons, which may not have strong connections with different PD experiences. But it may be telling that this gap seems so pervasive. Finding ways to connect the two may bring important criteria to what constitutes promising formal PD as well as a means to support more sustained learning among teachers. That is, if formal PD cannot be built upon during team time, it may not be helpful.

And if team time cannot connect to content from formal PD it may not be working on the most important learning or improvement goals.

Doing much more to connect formal PD with self-directed learning in teams offers a way to build sustained effort, which research underscores as key. Supovitz et al. (2000) found positive effects of formal PD when it was time intensive and ongoing, Yoon (2007) did so as well. This suggests that an important team and school leader contribution may be to engage in more deliberate efforts to connect different forms and lines of learning occurring in a school and among teacher groups. This may also mean that starting with formal PD may not be the best or only place. Sustained learning could begin in self-directed team learning and be enhanced through more formal opportunities that draw on experts, for example.

A more puzzling gap was between what teachers reported wanting to study and learn in their teams and what they actually spent their time on. In the teacher teams, there was work to understand the CCSS-M, often to discuss alignments of what to teach and when. However, despite expressing interest in learning more about the Standards for Mathematical Practice, focused conversations never came up during the team meetings. This may reflect the fact that the content of EM4 was so new and was a necessary focus at the time of this study. But this focus on curriculum topics, alignments and materials, rather than new approaches to math teaching and instruction expressed through the Standards for Mathematical Practice, may reflect known preferences among teachers to focus on curriculum over instructional strategies. Perhaps this remains true even among teachers who have developed trusting communities that involve open displays and replays of practice. As above, this suggests that leadership prompting and agenda setting may want to pay attention to this gap also.

Learning Continuums. While gaps and disconnections between formal PD and learning in teachers teams were observed, it seems clear that teacher learning and development does not, and need not, split into two separate buckets. There were varied forms, with some taking on characteristics of both formal and informal learning and self and other-directed learning. Specifically, the study observed a different category of teacher learning within schools: self-directed, formal PD. This surfaced through the story of fluency at North and math workshop at South. In these cases, requests for formal PD emerged from the work and needs of teams. This format may be responsive to a number of raised issues and needs and has the potential to create new opportunities for thinking about teacher learning in schools. This presents an exciting new way for schools to think and operate around teacher learning. It invites future inquiry as whether teachers who extend and enhance team learning through self-initiated PD end up learning and changing their practice more than teachers who keep the two separate, or even teachers who begin with formal PD that they then explore in the context of their teams.

Implications For Practice

This research explored the content, qualities and interactions between different forms of learning and learning contexts. One clear lesson is that leaders may have a lot of new work and thinking to develop to better support teacher learning.

The study has always been motivated by personal interests. My goal since entering the Ph.D. program has been to deepen my understanding and inform my work as a school administrator. I want to leverage resources within my organization in ways that have the greatest impact on teachers, teaching and student learning. Given this personal anchor, I offer implications in a less traditional form: a "letter to myself." I hope this form might speak more directly to other school leaders and connect some of my findings to their own experiences.

Dear David,

As you move forward in your career, there are implications from your study that can guide you in developing opportunities for teacher learning across formal PD, self-directed team, and self-directed PD settings. In terms of formal PD, recall how prior research findings played out in front of your eyes. Even though it is less expensive to send one or two teachers to a formal PD experience, the likelihood of those teachers returning and changing the practices of other teachers is small, unless deliberate steps are take to connect it to current work. Be wary of formal PD opportunities that are not ongoing or fail to challenge the thinking of teachers. Even though your teachers may enjoy the two-day conference and report back on how interesting and engaging it was, the chance of any real change in their practice is slim. Research has shown that formal PD needs to be substantial and sustained to have an impact on teachers (Corcoran et al., 2003; Supovitz & Turner, 2000; K. S. Yoon et al., 2007). Your study supported these claims. Rachael from South Elementary loved going to Chicago to the National EM4 conference and had agreed to bring her learning back to her team. She even commented how impactful it was in learning about the Standards for Mathematical Practice, yet she never brought this to her team's learning. If you are sending an individual or small group of teachers to a formal PD, please make sure there are protocols built into your school that push them to share and apply new knowledge in their teams and possibly even across your entire school. In addition, before agreeing to send teachers to these formal PD experiences, make sure an on-going learning plan is created so these experiences do not just fade away.

Work with formal and informal leaders to provide the supports teams need to be successful. Invest in leaders for your teams. Research shows that department leaders have a high impact on team participation by keeping a team's attention on instructional matters and by

serving as knowledge brokers and coordinators (Printy, 2008). Your study demonstrated this when Norah pushed her team to deepen their understandings of assessment of fluency and its implications for classroom practice. The conversations she pushed continued throughout your study and appears likely to continue into the foreseeable future.

Make sure you provide teachers with the time and space to come together in self-directed teams. This time is important and may be critical to their learning and practice. While some teams may struggle to be professional and productive, most work hard to collectively improve their practice and their student's outcomes. In his research, Wenger (1998) theorized that learning in CoP's developed through mutual engagement, joint enterprise, and a shared repertoire. In your study, two teacher teams mutually negotiated their work together. They developed a sense of joint enterprise through constant sharing and accountability to the group. Each team developed a shared repertoire over the course of the school year and negotiated meanings through routines, words, interactions, and tools.

Consider how you can support more specific instructional rehearsals and replays that help teachers dive into curriculum materials, instructional strategies and problems of practice in their classroom. By doing this, you create opportunities for collaborative teams to go beyond their comfort zone and to investigate materials and standards. You saw at South Elementary that the principal was an agenda setter. However, the agenda focused on the identification and creation of intervention groups. Things may have gone different if the agenda was on instruction within the intervention groups.

The exciting finding and implication from your study is what may happen at the intersection of self-directed teams and formal PD. What you saw at both North and South Elementary were situations where formal PD did not reflect best practices and did not align with

the learning needs of the teachers. You also saw that teacher teams, even teams with high levels of trust and functioning, were not always able to get on the same page with new ideas, in your case multiplication fluency and math workshop, despite formal PD. Moving forward, find opportunities for self-directed teams to find and or create PD that they are interested in and that supports the goals of your school. Don't think about teacher teams and formal PD as separate entities. Instead, think about how you can support the creation of more blended forms, including self-directed formal PD initiated by teams. Imagine how the story at North Elementary might have differed if all members had continued ongoing formal PD with fluency like Norah? By continuing the formal PD throughout the course of study, she was able to make sense of the research on multiplication fluency and apply it to her practice. Despite the other teachers at North Elementary having interest in the topic, the single self-directed formal PD was not enough to change their thinking or practice. Perhaps the key to focus on may be ongoing and sustained learning, more than formal or informal settings.

You also saw this at South Elementary in relationship to the self-directed PD on math workshop that Rachael and Katie took part in. Both continued to partner and learn about math workshop after the PD. This partnership was supported by the principal and changed instructional practices within their classroom. Wendy was very interested in joining their partnership but found, despite a strong desire to collaborate with Rachael and Katie, that not attending the formal PD limited her success and she gave up. Also, despite Rachael and Katie spending the majority of the February 11th team meeting sharing on math and their new classroom practices, math workshop was not instituted in any other classrooms. One might wonder if this outcome would have been different if all teachers at South Elementary would have been involved in the self-directed formal PD from the start.

Finding the funds to support all teachers of a team to engage in self-directed formal PD might not be the easiest; however, continuing to send individual teachers away to formal PD experiences that the entire team does not experience might be a waste of your school's budget. I would challenge you to chart a new course in terms of formal PD for your teacher teams. Begin with empathy and find out the desired learning needs of your teams. Help them to begin to link their formal PD needs with their desires for their self-directed teams. Partner with your teams to find or create self-directed ongoing formal PD that intersects their reported needs and supports the goals of your school. When they are going through the process of this new learning, make sure they have the time and space to make sense of their learning. Lastly, and most importantly, make sure the entire team is involved in the ongoing learning experiences.

It will be important for you to find ways to support your teams to allow them to connect learning across different experiences. Teachers reported a disconnect between their formal PD and work within their self-directed teams. You might think about leveraging the formal or informal leader to be an agenda setter that consistently connects the learning occurring across different experiences. Part of this connection also comes from making sure your teachers learning across different experience is meaningful to their practice. You saw in this study that when teachers did not find the learning meaningful, there was zero connection to the other contexts of learning.

This study helped to show the powerful nature of a mix of formal and informal learning. The focus of this study was the learning that occurred in formal PD and self-directed teams in relationship to the CCSS-M and EM4. When there was a disconnect and lack of expectations for participants in the learning experiences, opportunities and time were lost that can never be regained. When implementing major curriculum changes such as the CCSS-M and using new

resources, it is important to have the proper mix of formal and informal learning. It might be wise to use formal PD to push teachers out of their comfort zone and then allow them to process their new learning within their self-directed teams. Make sure both experiences are sustained and there is an opportunity at the formal PD to link the discussion occurring within the self-directed teams.

Summary Conclusions

Teachers are continuously asked to learn new skills, implement curriculum, and incorporate new standards of practice into their instruction. All of these place continuous professional learning demands on teachers. In this study, I have sought further understandings of CCSS-M mathematics reform and teacher's professional learning. Existing research shed light on specific activities that might lead to changes in teacher practice and student learning. To further this, I studied teachers' formal PD and self-directed learning, how well their activities aligned to research on conditions and practices that drive teacher learning along with changes in practice, and also how they interacted with each other.

A driving purpose of the study was to add to school leaders' understanding of how best to support teacher learning. Mathematics was a focus in this study, but insights may apply more broadly. This study found that formal PD is still struggling to make a difference in teacher's practice. It found that matching formal PD to varied teachers' needs was difficult and that schools assumed a sharing of knowledge from formal PD was occurring, when actually, it rarely happened. In fact, teachers did not connect their formal PD experiences to their self-directed teams. This study did find that teachers do meet and work professionally on substantive instructional matters. However, the norms created within teams can impact the nature of conversation and learning about curriculum. Teachers were able to use replays to learn more about curriculum materials. Lastly, an important finding from this study was the development of

the concept of self-directed formal PD. This showed promise in creating positive instructional changes among teachers. This finding may help create coordination and interactions among the learning contexts found in schools.

APPENDICES

APPENDIX A

Standards for Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively.

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved.

Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others.

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

CCSS.MATH.PRACTICE.MP4 Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry

software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

CCSS.MATH.PRACTICE.MP6 Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

CCSS.MATH.PRACTICE.MP7 Look for and make use of structure.

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7×8 equals the well remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x2 + 9x + 14$, older students can see the 14 as 2×7 and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning.

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points

are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y - 2)/(x - 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x - 1)(x + 1)$, $(x - 1)(x2 + x + 1)$, and $(x - 1)(x3 + x2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Connecting the Standards for Mathematical Practice to the Standards for Mathematical Content

The Standards for Mathematical Practice describe ways in which developing student practitioners of the discipline of mathematics increasingly ought to engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle and high school years. Designers of curricula, assessments, and professional development should all attend to the need to connect the mathematical practices to mathematical content in mathematics instruction.

The Standards for Mathematical Content are a balanced combination of procedure and understanding. Expectations that begin with the word "understand" are often especially good opportunities to connect the practices to the content. Students who lack understanding of a topic may rely on procedures too heavily. Without a flexible base from which to work, they may be less likely to consider analogous problems, represent problems coherently, justify conclusions, apply the mathematics to practical situations, use technology mindfully to work with the mathematics, explain the mathematics accurately to other students, step back for an overview, or deviate from a known procedure to find a shortcut. In short, a lack of understanding effectively prevents a student from engaging in the mathematical practices.

In this respect, those content standards which set an expectation of understanding are potential "points of intersection" between the Standards for Mathematical Content and the Standards for Mathematical Practice. These points of intersection are intended to be weighted toward central and generative concepts in the school mathematics curriculum that most merit the time, resources, innovative energies, and focus necessary to qualitatively improve the curriculum, instruction, assessment, professional development, and student achievement in mathematics.

APPENDIX B

Teacher Participant Survey

Mathematics educators around the country are transitioning to teach the Common Core State Standards in Mathematics (CCSS-M). This survey is part of a research study to examine the experiences of 4th grade teachers in formal learning and in more self-directed learning communities learning and negotiating how to develop all students' capabilities to meet the higher cognitive demands of the CCSS-M and the standards of mathematical practice related to the development of their conceptual understanding of mathematics.

This survey should take about 20 minutes to complete. Should you have any questions regarding the survey, please contact David Simpson at simps140@msu.edu.

Participation in this survey is voluntary, all responses are confidential, and all data from the questionnaire will be reported in the aggregate.

Thank you for participating in this survey!

Q1 I have carefully read the CCSS-M for 4th grade.
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q2 I have carefully read the Standards of Mathematical Practice in the CCSS-M.
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q3 The CCSS-M asks students to master more math content than previous math standards and expectations.
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q4 The CCSS-M asks students to learn more complex math skills than previous math standards and expectations.

❍ Strongly disagree
❍ Disagree
❍ Neither disagree nor agree
❍ Agree
❍ Strongly agree

Q5 The CCSS-M raises expectations for what all students should learn.
❍ Strongly disagree
❍ Disagree
❍ Neither disagree nor agree
❍ Agree
❍ Strongly agree

Q6 I am confident that at least 80% of my students will meet the standards and expectations of the CCSS-M.
❍ Strongly disagree
❍ Disagree
❍ Neither disagree nor agree
❍ Agree
❍ Strongly agree

Q7 I feel prepared to integrate the Standards of Mathematical Practice into my daily mathematics instruction.
❍ Strongly disagree
❍ Disagree
❍ Neither disagree nor agree
❍ Agree
❍ Strongly agree

Q8 How helpful would it be for you to learn more about the following Standards for Mathematical Practice?

	Not Helpful	Slightly Helpful	Helpful	Extremely Helpful
Make sense of problems and persevere in solving them	❍	❍	❍	❍
Reason abstractly and quantitatively	❍	❍	❍	❍
Construct viable arguments and critique the reasoning of	❍	❍	❍	❍

others				
Model with mathematics	❍	❍	❍	❍
Use appropriate tools strategically	❍	❍	❍	❍
Attend to precision	❍	❍	❍	❍
Look for and make use of structure	❍	❍	❍	❍
Look for and express regularity in repeated reasoning	❍	❍	❍	❍

Q9 Please rate the helpfulness of the formal professional development on EM4 and the CCSS-M.

	Not Helpful	Slightly Helpful	Helpful	Extremely Helpful
EM4 Open Response with Instructional Coach (March 2015)	❍	❍	❍	❍
PD with trainer from EM4 (August 2015)	❍	❍	❍	❍
PD with Instructional Coach (2015-16 School Year)	❍	❍	❍	❍

Q10 As a result of these formal professional development opportunities,

	Strongly	Disagree	Neither	Agree	Strongly

	disagree		disagree nor agree		agree
I developed a deeper understanding of the CCSS-M.	❍	❍	❍	❍	❍
I developed a deeper understanding of the CCSS-M Standards for Mathematical Practice.	❍	❍	❍	❍	❍
I developed instructional strategies and skills for teaching the CCSS-M content standards.	❍	❍	❍	❍	❍
I developed instructional strategies and skills for teaching the CCSS-M standards for mathematical practice.	❍	❍	❍	❍	❍
I learned about instructional materials that can promote the CCSS-M content standards.	❍	❍	❍	❍	❍
I learned about	❍	❍	❍	❍	❍

instructional materials that can promote the CCSS-M standards of mathematical practice.					
I learned more about designing assessments aligned to the CCSS-M.	❍	❍	❍	❍	❍
I learned more about existing materials for assessing students' understanding of the CCSS-M.	❍	❍	❍	❍	❍
I was able to learn about CCSS-M challenges that mattered to me personally.	❍	❍	❍	❍	❍

Q11 In my 4th grade team,

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
I developed a deeper understanding of the CCSS-M.	❍	❍	❍	❍	❍
I developed a deeper	❍	❍	❍	❍	❍

understanding of the CCSS-M Standards for Mathematical Practice.					
I developed instructional strategies and skills for teaching the CCSS-M content standards.	❍	❍	❍	❍	❍
I developed instructional strategies and skills for teaching the CCSS-M standards of mathematical practice.	❍	❍	❍	❍	❍
I learned about instructional materials that can promote the CCSS-M content standards.	❍	❍	❍	❍	❍
I learned about instructional materials that can promote the CCSS-M standards of mathematical practice.	❍	❍	❍	❍	❍
I learned more about designing	❍	❍	❍	❍	❍

assessments aligned to the CCSS-M.					
I learned more about existing materials for assessing students' understanding of the CCSS-M.	❍	❍	❍	❍	❍
I was able to learn about CCSS-M challenges that mattered to me personally.	❍	❍	❍	❍	❍
Our team developed shared understandings and strategies for teaching the CCSS-M standards and practices.	❍	❍	❍	❍	❍

Q12 Please rank the difficulty of the following CCSS-M implementation challenges in terms of your professional knowledge and skills (4=Most Difficult)

_____ Gaining a firm understanding of the CCSS-M content standards
_____ Gaining a firm understanding of the CCSS-M standards for mathematical practice
_____ Gaining a firm understanding of how students' mathematical thinking develops over time
_____ Aligning curriculum to the CCSS-M content and practice standards

Q13 Please rank the difficulty of the following CCSS-M implementation challenges in terms of curriculum planning (4=Most Difficult)

_____ Allotting time to discuss and plan lessons with my colleagues
_____ Creating lesson plans to embody the CCSS-M content standards
_____ Creating lesson plans to embody the CCSS-M standards for mathematical practice
_____ Monitoring student progress on mastering the CCSS-M standards

Q14 Please rank the difficulty of the following CCSS-M implementation challenges in terms of your students' learning needs (4=Most Difficult)
_____ Helping students develop the conceptual understandings outlined in the CCSS-M
_____ Helping students develop procedural fluency as outlined in the CCSS-M
_____ Helping students develop the standards for mathematical practice outlined in the CCSS-M
_____ Supporting students who struggle with the expectations of the CCSS-M

The following questions are about your 4th grade team

Q15 Our team has a formally designated leader
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q16 Our team practices shared leadership
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q17 Our team uses meeting agendas
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q18 We decide what to work on by consensus
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q19 Most of our team discussions are about very specific mathematics instruction issues
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q20 We stay focused on a few topics over several meetings

- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q21 I am comfortable sharing my teaching practices with members of my team
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q22 Members of our team observe each other teach and provide feedback to one another
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q23 This year the team spent time on topics that did not matter to me
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q24 I do not feel like our team made much progress with our concerns this year
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q25 My team regularly documents its work
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree
- ❍ Strongly agree

Q26 My team turns in progress reports or related documents to school leadership
- ❍ Strongly disagree
- ❍ Disagree
- ❍ Neither disagree nor agree
- ❍ Agree

❍ Strongly agree

Q27 We transform individual concerns into collaborative work
❍ Strongly disagree
❍ Disagree
❍ Neither disagree nor agree
❍ Agree
❍ Strongly agree

Q28 Members of my team know my strengths and challenge areas
❍ Strongly disagree
❍ Disagree
❍ Neither disagree nor agree
❍ Agree
❍ Strongly agree

Q29 Members of our grade level team share beliefs in how best to teach math
❍ Strongly disagree
❍ Disagree
❍ Neither disagree nor agree
❍ Agree
❍ Strongly agree

Q30 Members of our grade level team share beliefs in how children learn math
❍ Strongly disagree
❍ Disagree
❍ Neither disagree nor agree
❍ Agree
❍ Strongly agree

Q31 Members of our grade level team share beliefs in how to differentiate instruction for students
❍ Strongly disagree
❍ Disagree
❍ Neither disagree nor agree
❍ Agree
❍ Strongly agree

Q32 In regards to mathematics, I would like my 4th grade team to start doing...

Q33 In regards to mathematics, I would like my 4th grade team to stop doing...

Q34 During the next school year, what would you like to learn about the CCSS-M in the context of your 4th grade team?

Q35 During the next school year, what would you like to learn about the CCSS-M in the context of formal professional development?

Q36 Counting this school year, how many years have you been a school teacher?

Q37 Counting this school year, how many years have you taught in 4th grade?

Q38 Counting this school year, how many years have you taught in your current school?

Q39 What was your major field of study for your Bachelor's degree?
- ❍ Elementary Education
- ❍ Mathematics Education
- ❍ Mathematics
- ❍ Other disciplines (includes other Education fields, science, history, English, etc.

Q40 Do you have a Master's degree?
- ❍ Yes
- ❍ No

If Yes

Q40a Which best describes the field in which you received your Master's degree?
- ❍ Mathematics
- ❍ Other subject discipline (science, history, English, etc.)
- ❍ Teaching, learning, and assessment
- ❍ Instructional Technology
- ❍ Leadership, Administration
- ❍ Other education related
- ❍ Not education related

This questionnaire contained survey questions from the Common Core Survey Tool. This instrument was developed by several national education groups (U.S. Education Delivery Institute, Achieve, and Education First)

This questionnaire also contained survey questions from the National Education Longitudinal Study of 1988 (NELS:88). Questions were used from the First Follow-Up Teacher Questionnaire

APPENDIX C

District Leader Interview

Background information

What is your role in the district and how long have you been in this position?

How familiar are you with the Common Core State Standards in Mathematics (CCSS-M)?

a. How did you become familiar with the CCSS-M?
b. What changes do you expect will result from implementation of the CCSS-M?
    i. Changes in standards
    ii. Changes in instruction
    iii. Changes in assessment
c. The CCSS-M specifies mathematics content standards as well as mathematical practice standards. What is your understanding of what is now expected of students with regard to mathematics content?
d. What is your understanding of the expectations for student performance as outlined by the mathematical practices standards?

Current preparation efforts

These new standards emphasize conceptual understanding, as well as procedural fluency and the development of mathematical practices. As a result, new demands are being placed on teachers.

a. What efforts has the district made (does the district plan to take) to familiarize teachers and teacher leaders with the expectations for student performance under the CCSS-M?
b. What efforts has the district made (does the state plan to take) to revise and/or develop curricular documents to address the CCSS-M?
    i. Standards documents/objectives frameworks
    ii. Pacing guides
    iii. Lesson plans
c. What efforts has the district made (does the district plan to take) to adopt and implement new assessments/guidelines for assessments aligned with the CCSS-M?
        i. Do these apply to assessments implemented during the year as well as to end-of-year assessments?

d. What efforts have been made district wide to provide professional development and/or materials and guidance for teachers as they (prepare to) implement the CCSS-M?
    i. With regard to the mathematics content specified in the CCSS-M? (probe to understand whether focused on developing teachers' understanding of the standards and/or how to teach so that students meet the standards)
    ii. With regard to mathematical practices specified in the CCSS-M? (probe to understand whether focused on developing teachers' understanding of the standards and/or how to teach so that students meet the standards)

e. To what extent has the district encouraged teachers to rely on resources to support instruction?
    i. Online resources
    ii. Other resources
f. What has your role been in these efforts?

How well prepared do you think this district is for implementing the CCSS-M?

a. Why do you feel it is well prepared?/Why do you feel it is not well prepared? (probe for thoughts on preparation relative to content standards, practice standard and assessment)

What is your sense on how well prepared schools across the district are for implementing the CCSS-M?

a. Why do you feel the schools are well prepared?/Why do you feel the schools are not well prepared? (probe for content, practices, and assessment)

Challenges and needs

What do you perceive will be the biggest challenge at the district level for implementing the CCSS-M?

a. Why is this so challenging?

What supports are needed?

What challenges have schools in the district faced thus far in their implementation efforts?

a. Among these challenges you just listed, what do you perceive will be the biggest challenge at the school level for implementing the CCSS-M?
b. Why is this so challenging?
c. What supports are needed?

What challenges has the district faced thus far in efforts to implement the CCSS-M?

Are there any schools that are doing particularly well in implementing the CCSS-M?

a. What are these schools doing? To what do you attribute their success?

Are there any schools in the district that are struggling more than others?

a. What do you believe is the cause? What supports are needed to help bring the schools up to speed?

Resources and supports

What types of support (e.g., professional development, resources) do you think schools need to implement the CCSS-M?

a. What challenges do the district and schools face in providing these kinds of supports?

Has the district examined any curriculum resources to support schools in implementing the CCSS-M?

a. What resources in particular have you used/are you reviewing/considering using?
b. How did you go about finding these resources?
c. What role do you envision these resources will play in implementation efforts across the district?

This questionnaire contained survey questions from the Common Core Survey Tool. This instrument was developed by several national education groups (U.S. Education Delivery Institute, Achieve, and Education First)

APPENDIX D

Teacher Participant Interview

Background

Why did you become an educator?

Please describe yourself as a teacher.

What matters most to you as a teacher?

View of CCSS

Does your 4th grade team agree on what is more and less challenging about CCSS-M or do people differ in some of their views or concerns?

During this school year, you are implementing Everyday Math 4 (EM4). Think about a student you had last year that really struggled in math. How would you see that child this year with the implementation of EM4 in your class?

Formal learning activity

The district has provided three formal trainings with the launch of EM4. Can you tell me more about those three trainings?

What was the most impactful from these formal trainings?

What type of formally organized training and professional development for teaching and reaching the CCSS-M Standards and Practices have you received?

-Did these trainings prepare you to implement the Common Core Math Standards and the mathematical practices?

Collaborative learning

Can you tell me what the working routines for 4th grade teachers? Do you meet with other teachers beyond your grade level team to discuss math articulation, etc?

Beyond your grade level team, whom have you collaborated with around Common Core Math Standards and Practices? EM4?

-probe to determine if there is choice involved with the participants

-probe to find out if there is a leader, structure or routines to collaboration

-probe to determine formal and informal interactions

Individual learning

Have you engaged on learning or professional conversations about CCSS-M or EM4 outside what you have shared with me already?

-If necessary--- For example, in an online community, with other teacher colleagues and friends, through professional reading, etc.

Learning Gap

Thinking across these different learning contexts, do you have thoughts on what learning opportunities have been most helpful to you and who has been most helpful to you?

-Probe in terms of role and forms of knowledge and help

Is there a type of learning about CCSS-M or EM4 that has been missing for you or that you would like more of in the future?

In thinking about EM4, what would be the ideal Professional Learning and training supports for you?

Lastly, outside of matters such as time or money, do you have observations about how school and district leaders are most helpful to you and to teachers here in terms of EM4 and the CCSS-M?

This questionnaire contained survey questions from the Common Core Survey Tool. This instrument was developed by several national education groups (U.S. Education Delivery Institute, Achieve, and Education First)

APPENDIX E

Coding Scheme

1st Level Codes:

A Mathematics Discussion
Examples: discussion of content, lessons, sequences, instructional strategies, tasks, assignments, formative assessment, learning outcomes,

B Management of Teaching
Examples: report cards, parent communications, classroom management

C Other Curriculum Area Discussion
Examples: discussion of content, lessons, sequences, instructional strategies, tasks, assignments, formative assessment, learning outcomes,

D Other School Related
Discussions not about math or teaching but other topics
Examples: school/district directives, school-wide initiatives, evaluations

E Personal
Discussions not related to school
Examples: family discussion, personal narratives of events outside of school

2nd Level Codes:

Sub Codes of A 1st codes

Teacher replay of practice; TREP

Teacher rehearsal of practice; THEA

Reviewing student assessment data; RSAD

Exploring curriculum materials; EMAT

Challenges with teaching; CHAL

CCSS-M; STAN

Standards for Mathematical Practice; SMP

Curriculum alignment; CALL

Mathematical instructional practices; MIP

General instructional practices; GIP

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