University of California, Irvine

Mathematics Teacher Identity in the Context of Mathematics Reform:

Elementary Teacher Experiences

DISSERTATION

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requirements for the degree of

DOCTOR OF PHILOSOPHY

in Education

by

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DEDICATION

To my Family

My Parents: Leonard and Nancy

My Brothers: Jerry and Jeffrey

Without each of you supporting me, encouraging me, and above all believing in me *unconditionally*, I would not be where I am today. Thank you for accompanying me on this academic journey and for supporting me through it all.

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ABSTRACT OF THE DISSERTATION

Mathematics Teacher Identity in the Context of Mathematics Reform:
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By

Jennifer Sun

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Associate Professor Elizabeth A. van Es, Chair

Reform efforts and changes in mathematics education have brought on a shift towards a new vision of mathematics teaching in the United States. In light of recent accountability standards, the focus on teacher learning within the context of mathematics professional development is even more pressing. Prior research on teacher learning in the context of professional development has focused on how different teacher characteristics influence teacher learning, such as teaching experience, content knowledge, beliefs, and attitudes. Few studies have considered the role of mathematics teacher identity in relation to teacher learning and participation in professional development. In this dissertation, I explored the relationship between teachers' mathematics teacher identity and their experiences and participation within professional learning communities. Specifically, this study examined the construct of mathematics teacher identity in relation to teacher tensions and negotiations of tensions as they participated in mathematics professional development. Additionally, this study drew on the experiences of two novice teachers as they transitioned into new professional learning

communities with respect to their mathematics teacher identities. Data were drawn from semi-structured interviews, observations of professional learning community meetings, and teacher questionnaires collected over the course of one academic school year. Findings from this study highlight the importance of attending to mathematics teacher identity in relation to teacher learning in professional development. Specifically, mathematics teacher identity was found to play a role in the ways teachers learned, participated, and were positioned by others in their professional learning communities. In light of these findings, I propose the need for teacher educators and professional development programs to recognize the lived experiences and personal narratives that inform the mathematics teacher identity as well as to factor in how community shapes identity and teacher development when designing professional development experiences.

INTRODUCTION

Reform efforts and changes in mathematics education have brought on a shift towards a new vision of mathematics teaching in the United States (Ball & Cohen, 1999; Cohen & Hill, 2008; Common Core State Standards Initiative [CCSSI], 2010; National Council of Teachers Mathematics [NCTM], 2000; National Research Council [NRC], 2001). Proponents for reform-oriented mathematics teaching, what is being referred to as *ambitious instruction* (Jackson & Cobb, 2010; Kazemi, Franke, & Lampert, 2009; Lampert, Beasley, Ghousseini, Kazemi, & Franke, 2010), are moving teachers away from traditional approaches to teaching mathematics (teacher-directed, computational skills, memorization, etc.) and veering towards a more student-centered approach that is focused on attending to student engagement and development in areas of mathematical reasoning, problem solving, critical thinking, and conceptual understanding (Ball, Lubienski, & Mewborn, 2001; Boaler & Humphreys, 2005; CCSSI, 2010; Cohen & Ball, 1990; NCTM, 2000, NRC, 2001; Smith, 1996).

Mathematics reform under the Common Core State Standards Initiative draws on various processes of learning promoted by the National Council of Teachers in Mathematics and is a national effort towards building this new vision of mathematics teaching through standards-based instruction. This vision of mathematics teaching calls for teachers to cultivate learning spaces that are adaptive and responsive to student thinking (Carpenter & Lehrer, 1999; Jackson & Cobb, 2010). Researchers propose that to implement this new vision of mathematics teaching, teachers must learn to provide cognitively demanding tasks and facilitate mathematically rich discussions where students actively engage in mathematical reasoning and have opportunities to articulate and make their thinking visible (Kazemi, Franke, & Lampert, 2009; Lampert, Beasley, Ghousseini, Kazemi, & Franke, 2010; Stein, Engle, Smith, & Hughes, 2008; van Es & Sherin, 2008).

In the current context of mathematics reform, teachers are held accountable to this vision of mathematics teaching promoted by Common Core because students are now being assessed based on those standards. The Common Core standards provide a detailed focus on the content of mathematics learning, yet they provide little guidance on *how* the content should be taught by teachers (Porter, McMaken, Hwang, & Yang, 2011). With a lack of pedagogical guidelines to help teachers teach in ways envisioned by Common Core, teachers are confronted with the additional task of learning how to engage in practices that support this vision of reform-oriented mathematics teaching and learning.

This reform in mathematics teaching challenges the essence of what it means to be a teacher of mathematics in the United States. Teachers' identities as mathematics teachers influence how they navigate through the experiences of reform; furthermore, the tensions that arise during those experiences have an influence on their decision-making, practice, and learning (Alsup, 2006; Battey & Franke, 2008; Holland, Lachicotte, Skinner, & Cain, 1998). Productive tensions or productive disequilibrium are necessary for teacher learning (Lord, 1994; Stillman, 2011). In order for teachers to develop a new vision of mathematics teaching, they must be given the opportunity to grapple with tensions that challenge them to reflect on their philosophy of teaching in light of their experiences within the broader context of mathematics reform (Lord, 1994; Smagorinsky, Cook, Moore, Jackson, & Fry, 2004; Stillman, 2011; Tang, 2003).

In this dissertation, I explore the relationship between mathematics teacher identity and teachers' experiences in professional development (PD) in the context of mathematics reform. In particular, I investigate how mathematics teacher identity influenced teachers' experiences in professional development. This involved first exploring the different types of mathematics teacher identities that reflected the teachers in this study and then examining the relationship

between their mathematics teacher identity and the types of tensions that arose for them as well as how mathematics teacher identity informed the ways in which they negotiated the tensions they experienced. I also analyze mathematics teacher identity in relation to participation in professional learning communities, in particular, focusing on two novice teachers' experiences while transitioning into a new grade level community.

Contribution to the field

Prior research on teacher learning in the context of professional development has focused on how different teacher characteristics influence teacher learning, such as teaching experience, content knowledge, beliefs, and attitudes (Borko & Putnam, 1996; Cohen & Ball, 1990; Desimone, 2009; Grossman, 1990; Pajares, 1992; Peterson, Fennema, Carpenter, & Loef, 1989; Putnam & Borko, 2000; Richardson, 1996). Fewer studies have focused on the mediating role that mathematics teacher identity has in relation to teacher participation and learning in professional development (PD) (Jong, 2016). That is, little research explores how mathematics teacher identity informs teachers' participation in PD. A productive area of inquiry is to examine the nature of mathematics teacher identity when they enter PD, how that identity informs how they participate in this context, and the extent to which their mathematics teacher identity is manifested, upheld, and challenged in teacher learning.

The construct of mathematics teacher identity can provide insight into how and why teachers participate in PD in particular ways and provide a lens for understanding teacher learning and development. This study will contribute to building a better conceptualization of mathematics teacher identity and understanding its role in teachers' professional development experiences.

Research questions

This study draws from the socio-cultural perspective and situative theory of learning (Cobb & Bowers, 1999; Greeno, 1998; Lave & Wenger, 1991) to explore the relationship between mathematics teacher identity and teacher participation and learning in professional development. In particular, this study explores the following questions:

1. What is the relationship between mathematics teacher identities and teachers' experiences of tensions and negotiations in the context of professional development?

    - What are different types of mathematics teacher identities?
    - What are the different types of tensions that are experienced by teachers of varied mathematics teacher identities?
    - How do teachers of different identity types negotiate those tensions?

2. What is the relationship between mathematics teacher identities and teachers' participation in professional development?

    - What are the dimensions of competence that are embodied by grade level communities?
    - What role does mathematics teacher identity have on teachers' participation in new communities of practice?

CHAPTER 1

Literature Review

Identity

Identity has been defined differently in the literature based on the particular field and theoretical perspective. A broader conception of identity refers to it as being an influential construct that impacts the general aspects of "being." Vignoles and colleagues (2011) denote that in the most basic stance, identity involves how individuals convey "who they are." This identification can be conveyed individually or collectively, where the focus can be on analyzing "self" introspectively or through group affiliation. The perception of "who you are" encompasses many different factors and so it is not surprising that identity has been conceptualized and studied through diverse perspectives and methodologies (Erikson, 1968; Gee, 2001; Knowles, 1992; Goodson & Cole, 1994; Beijaard, Meijer, & Verloop, 2004).

Different fields of research (i.e., social/developmental psychology, sociology, and social sciences) situate and analyze identity at different levels. This process of defining "who you are" can involve a myriad of factors that stem from an individual, relational, and/or collective level. Identity can be looked upon as defining oneself at an individual basis (goals, values, beliefs), or with respect to others (ones role with others), or even through group affiliations (identification with groups they belong to) (Sedikides & Brewer, 2001). However, despite multiple interpretations in defining "identity," researchers agree that identity is *multifaceted, constantly evolving, and dynamic within a variety of contexts* (Beauchamp & Thomas, 2011; Beijaard, Meijer, & Verloop, 2004; Flores & Day, 2006; Hong, 2010).

Two approaches to studying the construct of identity are based upon the perspectives of whether or not identity is discovered or constructed. The discovery perspective (Waterman, 1984; 1999) argues that an individual's identity or "true self" already exists and is innate and

dormant, requiring an individual to "find and actualize that self or set of potentials" through social environments (Vignoles, Schwartz, & Luyckx, 2011, p. 11). This perspective is similar to Erikson's (1968) psychosocial perspective on identity formation where he conceptualized identity in different stages and found it to be influenced by biological maturation as well as through different social contexts (Beijaard, Meijer, & Verloop, 2004). Erickson viewed identity formation to be an outcome of the interaction between psychological experiences with the social environment (Schwartz, 2002). Through the maturation stages an individual is able to actualize his or her identity, "transforming their childhood identification into a coherent and personally meaningful identity" (Soenens & Vansteenkiste, 2011, p. 382).

The constructivist perspective argues that an individual's identity or "true self" does not previously exist and therefore must be "built," constructed and developed. The socio-cultural perspective draws from the constructivist approach and is based on the idea that an individual constructs or builds his or her identity through social learning and interactions within different contexts (Bjuland, Cestari, & Borgersen, 2012). In the socio-cultural perspective, identity has been generally defined as "who or what someone is, the various meanings people can attach to themselves, or the meanings attributed by others" (Beijaard, Verloop, & Vermunt, 2000, p. 750). Thus, learning is considered a process of "becoming;" it is identity formation where learners not only gain knowledge and skills but they also become a member in a professional community (Lave & Wenger, 1991). Wenger (1998) asserts that learning is seen as identity development in social interactions, "It is not just an accumulation of skills and information, but a process of becoming…It is in the formation of an identity that learning can become a source of meaningfulness and of personal and social energy" (p. 215). Therefore, the social interactions

and experiences that are encountered in different contexts provide opportunities for identity development.

Bronfenbrenner's (1989) Ecological Systems Theory model highlights how different *contexts* play a role in an individual's development. The Ecological Systems Theory is based on the notion that an individual grows and develops within the context of a system of relationships that stem from an individual's environment. Therefore, social interactions within particular contexts will shape the identity of an individual. Similar to Bronfenbrenner's (1989) systems theory, Lave and Wenger (1991) contend that learning is a social process and it is through participation in communities of practice where identity can be developed and shaped. Identity development is an ongoing process where an individual is interpreting and reinterpreting the experiences that he or she engages in different contexts (Beijaard,Verloop, & Vermunt, 2000).

Teacher Professional Identity

The development of teaching practices and subsequently the construction of teacher's professional identity are influenced by the personal beliefs and perceptions of teaching that come from individuals' past experiences in different contexts of teaching and learning (Clandinin & Connelly, 1995). Teacher professional identity development therefore involves the understanding of the self in relation to outside contexts—for the purposes of this study, contexts affiliated with being a mathematics teacher, including teacher preparation programs, policy reforms, schools, and learning communities (Wenger,1998). Sachs (2005) defines teacher professional identity as the "core" of the teaching profession, "It provides a framework for teachers to construct their own ideas of 'how to be,' 'how to act' and 'how to understand' their work and their place in society" (p. 15).

Teacher Professional Identity Development

Interaction between person and context (communities of practice) is critical to the formation of a teacher's professional identity and is considered a social process of learning "…the process of changing knowledgeable skill is subsumed in processes of changing identity in and through membership in a community of practitioners…" (Lave & Wenger, 1991, p. 64). A person's identity stems from his or her personal knowledge and experience, and when confronted with new ideas and conceptions within a particular community or context, the negotiation and adjustment of conflicting ideas allows for further identity formation (Wenger,1998). In the case where a teacher must learn new standards of teaching (i.e. Common Core) he or she is engaging in the process of adapting his or her identity in the midst of a larger broader social community and system, such as policy context or school context (Smagorinsky, Cook, Moore, Jackson, & Fry, 2004). In this view, learning is connected to identity development. It is through learning and participation in social activities where change could potentially be taking place and it is this process of change that foster identity development (Lave & Wenger, 1991; Lerman, 2006). Therefore, in the context where teachers are asked to learn and re-learn mathematics aligned with Common Core standards, they are essentially participating in a process of learning and change, and thus experiencing a potential shift in their identity as mathematics teachers.

Significance of Mathematics Teacher Identity

Mathematics teacher identity is important to consider as a mediating factor in the context of teaching and teacher development because it plays a role in how teachers come to view themselves and view students as "learners" and "doers" of mathematics and these perceptions influence the practices they take up in the classroom (Nicol & Crespo, 2003; Spillane, 2000; Walkington, 2005). Teacher identity contributes to how teachers come to understand their role in

the classroom, how they make sense of what it means to be a teacher in the discipline, and how teachers make decisions regarding everyday classroom practices (Battey & Franke, 2008). Teachers have their own perceptions of what it means to be a teacher and what it means to be a teacher of a particular discipline. Their teaching philosophies and the choices they make in relation to their practices can reveal insights about who they are as teachers. Teachers' personal knowledge, beliefs, values, emotions, and experiences concerning mathematics can influence how they make sense of the discipline they are teaching and the approaches they take to teach the discipline (Grootenboer & Ballantyne, 2010; Beijaard, Meijer, & Verloop, 2004). The pedagogical practices that teachers choose to incorporate into their instruction are influenced by their identity (Walkington, 2005; Mayer, 1999). Holland and colleagues (1998) consider identity as self-in-practice, where there is interpersonal connection between "self" and "practice." In the context of reform, where teachers are being asked to take up new practices, it is important to explore how identity influences their experiences within different contexts, which in this case is professional development and classroom practice (Kazemi & Hubbard, 2008).

Mathematics Teacher Identity in the Context of Professional Development

Research on mathematics teacher identity finds that identity plays a mediating role in teaching learning and practices. Teacher views, beliefs, and experiences with learning mathematics are interconnected and have influences on instructional practices (Brown & McNamara, 2011 Drake, 2006; Drake, Spillane, & Hufferd-Ackles, 2001; Stipek, Givvin, Salmon, & MacGyvers, 2001; Thompson, 1984). Peterson, Fennema, Carpenter, and Loef (1989) identified particular associations between teacher conceptions about teaching and instructional practices. Peterson and colleagues (1989) found that teachers who believed that mathematics learning involved students building their own understandings allocated more instructional time

dedicated to students solving word problems and developing counting strategies. In contrast, teachers who held more traditional views of mathematics learning were more inclined to spend instructional time telling the students about mathematical operations (Peterson et al., 1989).

Furthermore, mathematics teacher identity, informed by conceptions of mathematics learning, can influence how teachers respond to the current mathematics reform and professional development. Teacher identity has been shown to play a mediating role in how teachers enact reform mathematics teaching. Drake and colleagues (2001, 2006) explored the relationship between mathematics teacher identity, as reflected in narratives/stories regarding experiences with learning mathematics and teaching mathematics, and the different ways in which teachers (based on their storied identities) approached reform and implemented reform-oriented curriculum. They found that within the "storied identities" of teachers, it was important for teachers to experience some positive turning point with mathematics. Positive experiences allowed teachers to be more open and receptive to implementing changes to their practices that are aligned with reform expectations because they associated change with a more positive outlook.

Additionally, some research has examined how teacher identity can develop as teachers engage in opportunities for professional development. Hodgen and Askew (2007) found that the development of a positive mathematics teacher identity was linked with opportunities for collegial partnership, such as ongoing relationships and productive interactions with colleagues. Smagorinsky and colleagues (2004) view tensions to be the impetus for identity development. The different approaches to negotiating tensions that arise become opportunities for identity development. The learning opportunities and support structures that are made available to facilitate professional development can support or hinder the development of teacher identity.

Tensions, Negotiation, and Mathematics Teacher Identity

Tensions become opportunities for teacher learning and identity development whenever there is incongruence between teachers' own conception of what it means to teach (values, practices) and what is expected of them (policy mandates, CCSSI) (Beauchamp & Thomas, 2009). The term "tensions" has been referred to in teacher education literature as conflicts, difficulties, ideological dissonance, cognitive dissonance, dilemmas, and/or illustrative dualities (Alsup, 2006; Adler, 1998; Barab, Barnett, & Squire, 2002; Pillen, Beijaard, & den Brok, 2013; Pollock, Deckman, Mira, & Shalaby, 2010). Despite the negative emotions that may accompany tensions, experiencing tensions can have positive consequences for teacher learning (Van Veen & Lasky, 2005). Researchers contend that tensions are not necessarily negative in the context of teacher learning and development and can actually be viewed as productive learning opportunities (Graham, 1997; Pillen, Beijaard, & den Brok, 2013). Tensions can be productive when they involve an optimal combination of both "challenge" and "support" (Horn, Nolan, Ward, & Campbell, 2008; Mayer & Goldsberry, 1993; Smagorinsky et al., 2004; Tang, 2003).

Researchers contend that identities are developed as a result of the "refinement" and "adjustment" of their personal knowledge as they negotiate their experiences within different contexts (Alsup, 2006; Sutherland, Howard, & Markauskaite, 2010, p.456; Wenger, 1998). Particular contexts can provide learning opportunities that provoke tensions or productive disequilibrium *and* provide the necessary support to facilitate productive refinement and adjustment of knowledge to help negotiate the tensions. Learning takes place in the moments of reconciling conflicting tensions and this process also becomes an opportunity for teacher development (Beijaard, Verloop, &Vermunt, 2000; Lord, 1994; Smagorinsky et al., 2004; Wenger, 1998).

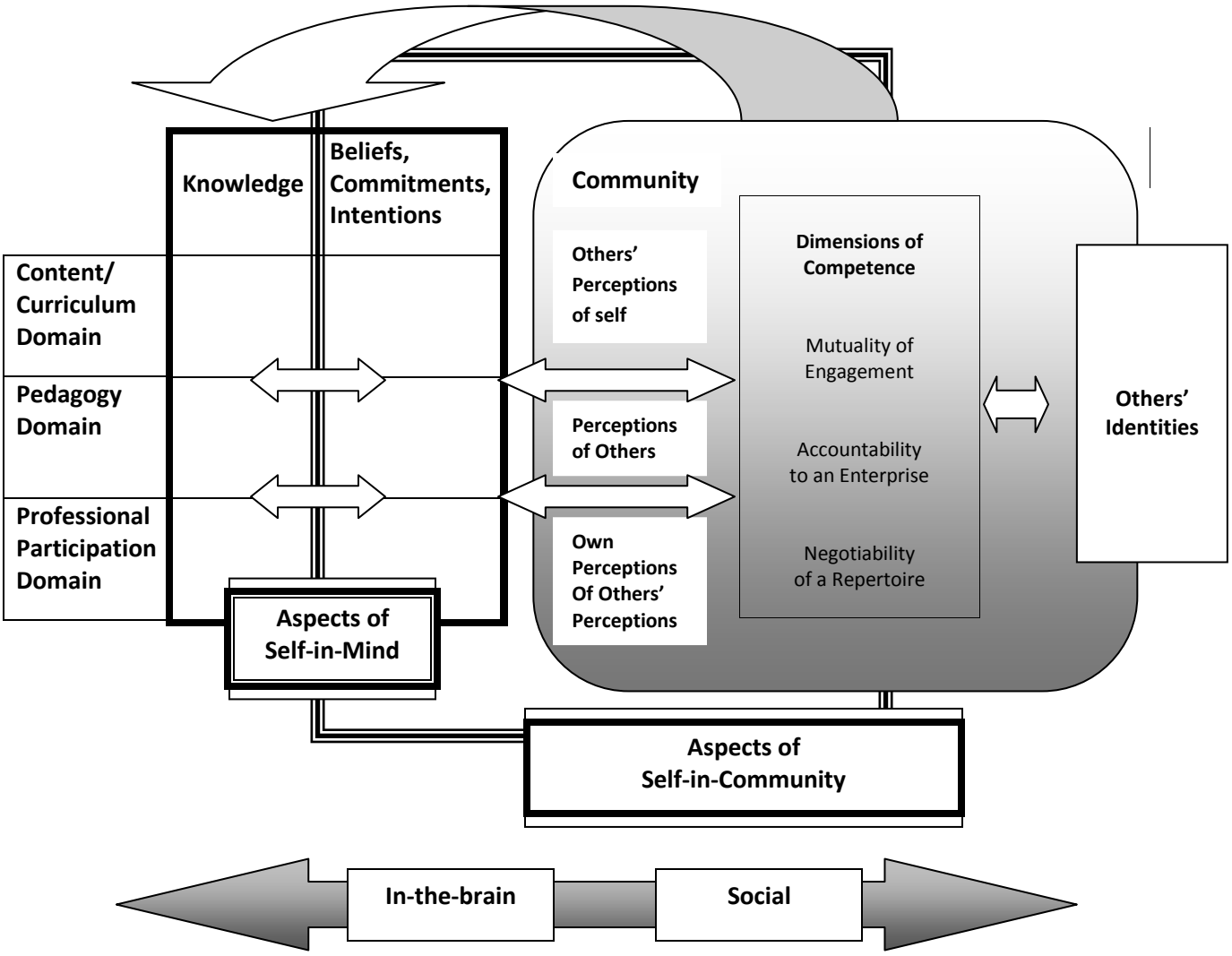
Tensions thus play an important role in the process of identity development. They become the stimuli that provoke teachers to engage in the process of refining and adjusting their knowledge. As teachers participate and interact with others in different professional development contexts they will have the opportunity to develop their mathematics teacher identities. I now turn to discuss the research design of this study.

CHAPTER 2

Research Design

Conceptual Framework

To understand the relationship between mathematics teacher identity and experiences within professional development, I drew on Van Zoest and Bohl's (2005) mathematics teacher identity framework to explore the relationship between mathematics teacher identity and experiences (tensions/negotiations) and participation (communities of practice) within professional development (see Figure 2.1).



Continuum of Forms of Learning and Knowing

Figure 2.1 *Mathematics Teacher Identity Framework (from Van Zoest & Bohl, 2005)*

Van Zoest and Bohl (2005) established a framework that captures the key components related to mathematics teacher identity development. Their framework for mathematics teacher identity reveals two interacting and overlapping components: *Aspects of Self-in-Mind* and *Aspects of Self-in-Community*. These components are built on the notion that teacher learning and development are socially and contextually dependent. "[Forms] of learning and knowing [lie on a] continuum, with in-the-brain on one end, social on the other, and every variation of combinations of the two stretched between them" (p. 332).

The framework draws from a theoretical perspective that brings together individual and social/contextual elements in the study of mathematics teacher identity formation. They situate their framework within Wenger's (1998) notion that development of identity is connected to learning within communities. I attended to several aspects of this framework to inform my study of teacher identity in relation to participation in professional development. The framework highlights that learning and knowing should be viewed as a continuum that stretches between cognition that resides in the individual and cognitive development that is influenced by social/contextual elements.

First, the framework attends to elements that are cognitive in nature, thus viewed as residing in the individuals' heads. It is referred to as *Aspects of Self-in-Mind*. It highlights three categories related to the domains of cognition: content/curriculum, pedagogy, and professional development. The framework points to how teacher knowledge, beliefs, commitments, and intentions interact within the domains of cognition. The knowledge, beliefs, commitments, and intentions that are developed in the content of curriculum, pedagogy, and professional development are components of teacher identity. Teacher commitment and intentions influence how teachers choose to act (participate/respond) in different situations. Commitment and intentions relate to how individuals will act in different contexts based on what they know or believe.

Second, the framework also considers that individuals are nested within various communities (social context), and these communities influence identity development. The framework highlights that beliefs, commitments and intentions overlap between *Aspects of Self-in-Mind* and *Aspects of Self-in-Community*. This is to show that these components influence peoples' interactions and experiences within social contexts *and* these experiences become

opportunities for identity development. *Aspects of Self-in-Community* attend to perceptions. It focuses on how perceptions mediate the ways in which people choose to participate in particular contexts. Therefore, teacher's perception *of self*, *of others*, and *of others' perceptions* are included in this domain to highlight the bidirectional influence that perceptions, in other contexts, have on developing individual beliefs, commitments, and intentions. The framework also highlights an additional dimension in *Aspects of Self-in-Community* to be "Dimensions of Competence: mutuality of engagement, accountability to an enterprise, and negotiability of a repertoire"—*Mutuality of Engagement* refers to teachers building competence in knowing the ways to participate and interact in a given community, *Accountability to an Enterprise* refers to teachers' competence in relation to meeting the standards that are held by the particular community (i.e., curriculum), and *Negotiability of a Repertoire* refers to teachers being able to negotiate and adjust their knowledge and modes of participation with the social practices in a given community.

With this framework in mind, this dissertation explores the relationship between mathematics teacher identities and teachers' experiences in professional development (PD) in the context of mathematics reform. I explore the nature of mathematics teacher identity and their experiences in professional development, specifically the types of tensions that arise for them in professional development, and how they negotiate those tensions. The design of this study is qualitative in nature which requires me to spend an extensive period of time observing and experiencing the professional development sessions in which the teachers in this study participated. Multiple sources of data (interviews, observations, questionnaires) were collected in the span of an entire academic school year. This dissertation study also required teacher participants to feel comfortable with sharing their experiences with me. Thus, a crucial process in

this study was to establish rapport and trust with the teachers in this study. An extensive amount of time was dedicated to developing rapport with the teachers in the study. Using qualitative data (observations, questionnaires, interviews) I first explore the developing mathematics teacher identities that existed among the teachers in this study, I then examine the relationship between teacher mathematics identity types and the types of tensions that were experienced in the context of mathematics professional development, in particular, if there was a relationship between their mathematics teacher identity types and negotiation of tensions. Finally, I examine the relationship between mathematics teacher identities and teachers' participation in professional development. I first analyze the dimensions of competence that were embodied by the grade level communities, and then utilize two case studies of teacher experiences to explore the role that mathematics teacher identity had on new teachers' participation in communities of practice.

Study Context

This study took place in a K-8 charter school located in Southern California. The school uses a project-based curriculum that addresses multiple subject matters. The school has a teaching staff of 30 classroom teachers who instruct and support approximately 569 students. The teachers in each grade level follow a co-teaching model, particular grade levels might have two teachers who co-teach in a shared classroom or a grade level could include a "floater" teacher who provides instructional support between two classrooms and two teachers. This school was selected for this study of mathematics teacher identity in the context of mathematics reform because it was in the process of developing a sustained professional development in the context of mathematics with the goals to establish a shared vision of teaching school-wide. The school sought to make changes to its systems and structures as a way to develop a consistent shared vision of teaching and teacher practices. In addition the school recognized the importance

of providing their teachers with opportunities for continuous professional development, especially in relation to their instructional practices in the context of mathematics in response to Common Core. The school also had built a relationship with the county's department of education and local university. Teacher educators at the university as well as the county's department of education have worked with the teachers at the school in other professional development capacities before. The charter school collaborated with the county's department of education to design and facilitate professional development focused on establishing new school-wide systems and structures in an effort to meet the demands of mathematics reform and to build internal capacity to ensure sustained change.

In collaboration with the county's department of education, a model of professional development was created with the intended goal of developing a school-wide shared vision of mathematics teaching that was aligned with ambitious mathematical practices and Common Core State Standards Initiative. The duration of the professional development was intended for a two year period, where the first year would focus on systems structures in the context of mathematics and year two would be focused on language arts. In essence, the two year period was designed to help support the school in achieving internal capacity. The intended outcome was that after two years, the school would be self-sufficient and that the teachers would have the capacity to continue the work on their own—therefore, having the capacity to sustain the practices that they developed during the two years. This study focused on year one, where professional development was focused on mathematics.

Description and Goals of Professional Development

The professional development was designed to support teachers in four areas: develop a deeper understanding of the Common Core state standards and use them to help guide

instruction, learn how to develop learning goals and plan instructional activities that will meet learning objectives, learn to design and use tools to measure student progress toward learning goals, and lastly, learn to analyze and use classroom level data (timely) to plan instruction. That is, the analysis of student data would influence the instruction for the following day or week. To help the school meet these goals, the professional development model included different components – two coaches (who were former teachers), monthly afterschool Professional Development (PD) sessions/workshops, and weekly Professional Learning Community (PLC) meetings. Coaches were brought in to provide teacher support in each grade level. During the PLC meetings coaches would be present to help support and facilitate instructional planning and teaching in mathematics. In addition to three full-day summer PD sessions, there would be eleven monthly professional development sessions scheduled throughout the academic year, meeting about once a month.

The monthly PD sessions focused on building a vision of ambitious mathematics teaching. Topics were focused on developing practices for initiating and facilitating discourse-rich classrooms (Hufford-Ackles, Fuson, & Sherin, 2014), engaging in the five practices for orchestrating productive discussions (Stein & Smith, 2011), and viewing videos of exemplary teachers enacting practices for eliciting and probing student thinking (Teaching Channel). Teachers engaged in activities where they collaborated to unpack Common Core standards in mathematics, develop and assess learning goals, understand mathematics processes, and design tools to measure student progress. The professional development intended to address the need to establish a school-wide system in the process of unit planning. It provided teachers with specific protocols and processes to support their efforts in analyzing student data and unit planning.

The weekly grade level PLC meetings intended to provide a shared space where teachers could continuously engage in practices that were addressed during PD sessions/workshops within their respective grade levels. During PLC meetings teachers worked together to develop deeper understandings of Common Core math standards and develop curriculum maps that articulated the main learning goals and learning objectives. They were tasked to analyze and use classroom level data to plan instruction. In addition, teachers worked with their grade level teams and coach to identify tools and materials (e.g. curriculum materials) that would support them in achieving these learning goals. A component of the professional development design was also intended to help support teacher practices. It was designed for teachers and coaches in each grade level to engage in math workshops, similar to lesson studies, where they planned a lesson together--discussing ways to monitor student progress and the approaches they would take to assess student learning outcomes for lessons prior to teaching them, and then teaching the lesson in their respective classrooms.

Teacher Recruitment

All teachers in grades K-5 were invited to participate in the study in the 2015-2016 school year. The study was limited to teachers in grades K-5 because they were the grade levels that would be given the support of a coach during the year. I conducted an official recruitment of teachers during the first staff meeting that was offered in September. I was given the opportunity to give a brief presentation for the teachers. During this presentation, I introduced the purpose of the study and also explained what would be required of teachers if they chose to participate (i.e. observations, audio-recorded interviews). I gave teachers study information to take home which included a consent form during this meeting as well. Teachers interested in participating in the year-long study were directed to return their signed consent forms the following week.

Teacher Participants

Participating teachers in the study came from kindergarten and 5th grade. A total of seven teachers from grades K and 5th represent the teacher participants in this study. Out of the six teachers in kindergarten, four of the teachers consented to be a part of the study. All three teachers in 5th grade became participants as well. Teacher age ranged from 27-45 years old (mean=34.4) and teaching experiences ranged from 1-11 years (mean=4.7). Three teachers (Mia, Lucy, Heather) were considered "veteran" teachers not because of their accumulated years of teaching experience but due to them being the first group of teachers who taught at the school when it opened. Kindergarten used a co-teaching model, where each classroom was run by two teachers. In 5th grade the division of classroom responsibilities was divided among three teachers, where one teacher (Claire) would essentially travel between two classrooms and co-teach/support the teacher in that designated class.

Table 2.1

Teacher participants

Teacher	Grade Level	Age	Years of teaching experience
Laura	K	36	1
Emma	K	28	5
Mia	K	29	6
Olivia	K	27	3
Lucy	5	33	5
Claire	5	45	2
Heather	5	43	11

Note: All names above are pseudonyms.

Data

I collected multiple data sources from three contexts: professional development, professional learning community, and teacher classroom. In addition to collecting data from teachers, I also conducted interviews with the principal, two coaches, and PD designer/facilitator.

- Life Story Interviews (Oct-Dec)—7 Total with audio-recording
- Three mathematics lesson observations (Feb-June)--Video recording and observation fields notes for each teacher---20 total (Olivia only had two math lesson observations)
- Post-Observation Follow-up Interview (Feb-June) after each mathematics lesson observation, I conducted a post-observation interview for each teacher. The interview had three different components: Part A was designed for teachers to reflect and share their perspectives on their mathematics lesson that was just observed. Part B included questions intended to have teachers share their perspectives and experiences in the context of mathematics professional development. Part C asked teachers to reflect on their tensions and negotiations of tensions during that time—21 total
- Video recording and observation field notes for weekly professional learning community meetings for kindergarten and 5^{th} grade (69 total: 35 in kindergarten & 34 in 5^{th} grade)
- Video recording and observation field notes for monthly PD sessions (Oct-May: eleven total)
- Post-PD questionnaire (52 total)
- Observation Field notes for summer PD session (Aug: three total)
- Two interviews with principal with audio-recording (Background, Project goals, Tensions & Negotiations, Perceptions)
- Two interviews for each coach with audio-recording (Life Story and Exit—four total)

- Two interviews with PD designer/facilitator (Background, Project goals, Tensions & Negotiations, Perceptions)
- Teacher questionnaire (six total)

In the next section, I present the data sources and collection methods that correspond to research question one and research question two separately.

Research Question One: Data Sources and Collection Methods

The first research question focused on exploring the relationship between mathematics teacher identities and teachers' experiences of tensions and negotiations in the context of professional development?

- What are different types of mathematics teacher identities?
- What are the different types of tensions that are experienced by teachers of varied mathematics teacher identities?
- How do teachers of different identity types negotiate those tensions?

Life Story interview. I conducted a semi-structured Life Story interview for all seven teachers during the Fall of 2015 (Oct-Dec) (see Appendix A). The development of the Life Story interview was informed by research on the role of reflection in the study of teacher identity where it is argued that the process of reflecting is an element in the shaping of identity (Beauchamp & Thomas, 2009). The Life Story interview was designed with two different sections that include questions that encouraged teachers to engage in reflection that was both prospective and retrospective in nature (Conway, 2001; Rodgers, 2002). The first half of the interview included a variety of questions that encouraged teachers to reflect on and talk about their prior schooling experiences, their motivations for becoming a teacher, their perspectives on mathematics teaching, and their knowledge and understanding of current issues in mathematics

education. These questions were intended to allow teachers to reflect on and share their perspectives and knowledge on various topics that relate to their educational experiences both as a student and a developing teacher. The latter portion of the interview included an established interview protocol that encouraged teachers to reflect on and share stories about their life experiences with mathematics (Drake, Spillane, & Hufferd-Ackles, 2001; McAdams, 1993). These questions encouraged teachers to reflect on pivotal moments in their experiences learning and teaching mathematics. The semi-structured format of the Life Story interview afforded the opportunity to develop rapport with the teachers so that they were able to share more openly. Interviews developed more into conversations between me and the teachers. Each interview lasted approximately 1-1.5 hours and was audio-recorded and transcribed.

Teacher questionnaire. The teacher questionnaire required teachers to express their perceptions of their mathematics teacher identity, school culture, relationships with colleagues, and teacher preparation experiences (see Appendix B). The teacher questionnaire served as an extension of the Life Story interview and it provided additional insight into teacher experience, background, and perceptions. Teachers were sent the questionnaires via email in the fall as a way to "get to know" the teachers prior to conducting the Life Story interviews. It was also a way to situate teachers in the study and prepare them to begin engaging in the process of reflection. Teachers responded to the questionnaire electronically by typing directly onto the document. One teacher, Olivia, did not submit responses; instead she preferred responding to questions in a face-to-face interview.

Post-observation follow-up interviews. I conducted a semi-structured post-observation follow-up interview three times during the course of the school year (Feb-June) after mathematics lesson observations for each teacher. The interview was designed with multiple

parts as a way to address the issue of teacher availability and to maximize each interview time. Thus, the Post-observation Follow-up interview was designed to serve the purpose of collecting data for both research question one and research question two at one time. Each Post-observation Follow-up interview was designed to capture three different components. Part A was designed for teachers to reflect and share their perspectives on the mathematics lesson that was just observed, with a particular focus on the learning goals and the practices observed. The goal was to allow teachers to speak to the practices and thought processes they engaged in during the lesson and to get an understanding on how mathematics lessons were structured in the classroom. Part B included questions intended to have teachers share their perspectives and experiences in the context of mathematics professional development. Part C asked teachers to reflect on their tensions and negotiations of tensions during that time. Questions were slightly modified and adapted based on each preceding interview to account for issues or questions that emerged in the school context or professional development during the period between interviews (Creswell, 2007) (see Appendices D, E, F) The third Post-observation Follow-up interview also served the purpose of an "Exit" interview, where I asked teachers to reflect on their perceptions and experiences throughout the whole year (see Appendix F). Each interview lasted between 30 minutes to an hour, with the final interview lasting approximately 1-1.5 hours. I audio-recorded and transcribed all interviews.

Post-PD questionnaires. The post-PD questionnaire was intended to gain additional insight regarding teachers' perception of their learning experiences during the monthly professional development sessions. The questionnaire included questions that asked teachers to reflect on what they learned and if they found the PD to be helpful or not. In addition, teachers were also asked to comment on any tensions that they experienced or were currently

experiencing at the time (see Appendix C). I distributed the Post-PD questionnaires to the teachers after each PD session beginning in October. Each questionnaire included five open response questions and I collected them after each session for the teachers that attended.

Research Question Two: Data Sources and Collection Methods

Research question two focused on exploring the relationship between mathematics teacher identities and teachers' participation in professional development?

- What are the dimensions of competence that are embodied by grade level communities?
- What role does mathematics teacher identity have on teachers' participation in new communities of practice?

Professional Learning Community (PLC) meeting observation field notes/video recording of meetings. I attended the weekly professional learning community meetings for both kindergarten and 5th grade (34 and 35 meetings respectively). Each grade level met two times per week throughout the academic year. I video-recorded and wrote up observation field notes for each meeting. Some critical features of professional development that help to increase teacher knowledge and improve practices were identified in the literature as: content focus, active learning, coherence, duration, collective participation, and critical colleagueship (Desimone, 2009; Lord, 1994; Loucks-Horsley & Matusmoto, 1999). To help guide my observations, I focused my attention on the absence or presence of these critical features during each meeting.

The purpose of writing observational field notes was to be able to document what was occurring in each meeting and to document how teachers were participating with the content and interacting with each other. Therefore, I placed particular focus on describing what was to be learned during each session (content), how the content was to be learned (process), how the content was organized for learning (strategies & structures), the conditions in which the content

was to be learned (context), documenting teacher participation and engagement, and lastly documenting teacher interactions with each other (Loucks-Horsley, & Matsumoto, 1999). My observation field notes also at times included the dialogue between teachers during the meetings. Both grade levels met twice a week and their meetings generally ranged between 1-2.5 hours. Each grade level was also given a full day to unit plan with their PLC in March. All teachers were excused from teaching on that designated day and met together on campus to unit plan.

Post-observation follow-up interviews. To investigate research question two, I attended to the questions and responses in which teachers shared their perspectives and experiences in the context of mathematics professional development (Part B & C). As stated previously, questions were slightly modified and adapted based on each preceding interview to account for issues or questions that emerged in the school context or professional development during the period between interviews (Creswell, 2007). Teachers were also asked questions regarding their perceptions of other teachers in their professional learning community (see Appendix D & E).

With these data sources in mind, the next chapter focuses on the qualitative data analysis approach that I took to answer research question one and two.

CHAPTER 3

Data Analysis

Research question one and sub-questions: What is the relationship between mathematics teacher identities and teachers' experiences of tensions and negotiations in the context of professional development? What are different types of mathematics teacher identities? What are the different types of tensions that are experienced by teachers of varied mathematics teacher identities? How do teachers of different identity types negotiate those tensions?

The most common approaches to studying the construct of identity have relied on the methods of narratives (Connelly & Clandinin, 1999; Drake, Spillane, Hufford-Ackles, 2001;Sfard & Prusak, 2005), surveys, questionnaires (Beijaard, Verloop, & Vermunt, 2009), and different types of interviews that focus on teachers reflecting on their life stories, perspectives, and experiences (McAdams, 2001; Mitchell, 1997; DeCorse & Vogtle, 1997; Drake, Spillane, & Hufferd-Ackles, 2001; Soreide, 2006). I used a combination of these approaches as a way to triangulate data. To answer research question one I drew from four data sources: Life Story interviews, Post-observation Follow-up Interviews, Teacher questionnaire, and Post-PD questionnaire. A brief description of the data sources that I used to answer research question one (sub-questions) is provided in Table 3.1, followed by a more detailed description of the data and collection methods.

Table 3.1

Research Question One and Data Sources

RQ1: What is the relationship between mathematics teacher identities and teachers' experiences of tensions and negotiations in the context of professional development?	
Sub-questions	Data
What are the different types of mathematics teacher identities?	Transcripts from Life Story interviews Transcripts from Post-Observation Follow-up

	Interviews (3 per teacher, 21 total) Teacher questionnaire responses
What are the different types of tensions experienced by teachers of varied mathematics teacher identities?	Transcripts from Post-observation Follow-up Interviews(3 per teacher, 21 total) Post-PD questionnaire responses
How do teachers of different mathematics identity types negotiate tensions?	Transcripts from Post-observation Follow-up Interviews (3 per teacher, 21 total) Post-PD questionnaire responses

The method I used in the analysis of research question one included both an interpretative and thematic approach (Creswell, 2007). To answer research question one involved three separate analyses each involving several steps. Phase one involved identifying the mathematics teacher identity types that emerged for the teachers in this study. Phase two involved identifying the tensions that were experienced by the teachers in the context of mathematics professional development. Phase three consisted of describing the different ways that teachers negotiated tensions in relation to their mathematics teacher identity types. I utilized an inductive approach that involved an analysis process that was both iterative and reflexive. In the following sections, I break down research question one into the three sub-questions and provide a description of the data sources used followed by a description of the analysis for each data source.

Sub-question one: What are the different types of mathematics teacher identities?

Analysis of Life Story interviews. I transcribed the Life Story interviews and made an effort to include time stamps associated with each question that was asked. This allowed for easier access to the audio-recordings during the analysis process. The analysis of the Life Story interview consisted of two parts where the first step was to analyze Part A of the interview where teacher responses were associated with their background, motivation, and perspectives on teaching mathematics. Part B analysis focused on their life experiences with mathematics, in

particular, the pivotal moments they recalled. I analyzed each teacher's Life Story interview separately (vertical analysis) followed by a cross-case analysis (horizontal analysis) (Miles & Huberman, 1994). I used the constant comparative analysis (Glaser & Strauss, 1965) to find patterns and differences among the teacher interview responses.

To familiarize myself with the teachers in this study, I first utilized a content analysis approach as I read through each Life Story transcript. The goal was to develop an overall understanding of the experiences, knowledge, and perspectives of each teacher in the context of teaching and mathematics. I read through each transcript and wrote analytic memos to summarize teacher responses for each question asked as well as highlighting noteworthy reflections from teachers. This was then followed by a more detailed analysis of the analytic memos and its corresponding question. The lens I took for this analysis was informed by the literature on identity formation (Antonek, McCormick, & Donato, 1997; Beauchamp & Thomas, 2011; Beijaard et al., 2004; Day, Kington, Stobart, & Sammons, 2006; Flores & Day, 2006; Lasky, 2005; Ponticell, 2003; Reio, 2005) and Van Zoest and Bohl's (2005) framework on mathematics teacher identity, in particular, the *Aspects of Self-in-Mind* dimension. I developed categorical bins to help organize the analytic memos and its corresponding question for each teacher. The categorical bins developed included teachers' views on the topic of *mathematics*—including knowledge and understanding of current issues in mathematics education, motivations to becoming a teacher, self-efficacy, views and perspectives regarding *pedagogy*, experiences and perceptions related to *professional development*. I created a data matrix to organize teacher responses associated with the categories. I anticipated adding on to these categories as I continued to analyze the teacher questionnaire and Post-observation Follow-up Interviews. The

data matrix allowed for cross-comparison analysis. Table 3.2 presents an example of the organization of particular Life Story responses into the three categories for one teacher.

Table 3.2

Categorical bins in the analysis of teacher responses from Life Story interviews

Preliminary Categorical bins	Description	Teacher example
Views on mathematics—including knowledge and understanding of current issues in mathematics education.	Knowledge, beliefs, values, or expressed commitments toward the learning of the mathematics subject	"**championer of math**" right this point I'm the launch, so…under my watch, they're going to see me really excited about math." "...like thinking like different ways to think about numbers…and to like discover, make discoveries about it…I think it's just so exciting…like the sense making process… and… **I want them to see it as like something that they are capable of."** "I was excited that No Child Left Behind was going to be **reformed and gotten rid of or there was some shift in education cause I could tell you that's not working** you know…so I was excited about…like as I started reading more and more about what… the intentions were behind the standards, it just really made sense."
Views of pedagogy	Reflections associated with teaching practices, learning opportunities, dynamics in the classroom	Teacher role is to be a **facilitator** Types of learning opportunities that are best for students: **making connections, sharing out, multiple strategies, CGI** "… really where they're **making sense of it** or like trying to understand their thinking…um…I think is the most effective." Enjoy most about teaching: **getting students excited to learn**
Views of professional development	Reflections associated with experiences participating in professional development	"…and then here we've had **PD around common core standards for math**… and in all of our professional development like we're **really putting them in the fore fron**t."

The next step was to analyze the second portion of the Life Story interview, where teachers reflected on their experiences with mathematics. Again, I read through each response using a content analysis approach and wrote analytic memos as a way to familiarize myself with the data as a whole. I was interested in focusing on the particular experiences and events that teachers recalled with strong feelings and specificity. Having the ability to recall an experience or event with strong feelings and specificity was inferred as being a pivotal and influential event in the teacher's Life Story experience with mathematics (Drake, 2006; McAdams, Diamond, de St. Aubin, & Mansfield, 1997). I chose to focus, in particular, on what teachers recalled as being their *peak experience, nadir experience, turning point,* and *greatest challenge* in the context of mathematics (Drake, 2006; Drake, Spillane & Hufferd-Ackles, 2001). I recorded and organized each teacher's reflection regarding the four key aspects on the data matrix. Given that most teachers had difficulty quickly recalling on mathematics experiences within those constraints without probing, I chose to only focus on the events that were easily recalled without probing and that were described with specificity (what happened, who was there, how did it make you feel) (Drake & Sherin, 2006). Only these specific events were later included in the process of generating the mathematics teacher identity. For example, Laura's recall of her nadir experience (lowest point) and negative experiences associated with mathematics involved a particular mathematics teacher and the way he made her feel. She associated that period as "miserable" and "painful," and this experience was easily recalled by Laura, signifying the impact it had on her.

> He would humiliate me and he made me **feel really stupid**, and I use that term like "make me feel," but like really I felt like that was his mission…Like he was so cruel like **I get angry** like thinking about the way that I felt in his class because I'm like, **you should never make a student feel that way** you know.

I had this kind of **fear** of math because it had been such a like a subject where I **really shrunk** like I tried **to be invisible** in that class because I had no clue what was going on…because again I checked out in Pre-Algebra..Algebra's going to be hard you know…

The negative effect that was associated with this particular experience impacted her relationship with mathematics later on and she associated it with how she chose to interact with her students--always being there to support and encourage students, and ultimately, not wanting students to be fearful of mathematics, especially girls. This pivotal event had an impact on her views and beliefs regarding her role as a mathematics teacher.

Teacher questionnaire. I followed a similar process in the analysis of the teacher questionnaire. I wrote analytic memos as I read through the responses for each teacher. The analysis of the questionnaire was dependent on how much the teachers chose to write. For example, some teachers provided responses with more detail whereas others opted to include brief one word responses. The teacher questionnaire provided a supplementary source to the Life Story interviews, allowing for teachers to share and elaborate more on their perceptions regarding their own mathematics teacher identity, school culture/context, and experiences in teacher preparation programs.

Analysis of post-observation follow-up interviews. As stated previously, because the Post-observation Follow-up Interview was designed as a way to maximize each interview and teacher availability, particular sections were included as a way to collect data for both research question one and research question two at one time. I segmented the interview transcripts by question types to help organize and manage the data for ease of analysis in relation to particular research questions. The unit of analysis was each response associated with a particular question or idea (Miles & Huberman, 1994). I utilized the *Aspects of Self-in-Mind* dimension and coded

each unit of analysis based on whether it was associated with views/perceptions on mathematics (content/curriculum/role of mathematics), views/perceptions on pedagogy, and views/perceptions on professional development. For particular segments that did not fall within these particular codes, I wrote a memo based on what the focus was (e.g., perception of others). For each segmented response (unit of analysis), it was either coded as PD (professional development), Pedagogy, Perception of others, or MC (mathematics content—ex. Content/curriculum), followed by an analytic memo. Table 3.3 provides an example of this coding process.

Table 3.3

Example of analysis of Post-Observation Follow-up Interviews

Question & Time Stamp	**Transcript segment**	**Code**	**Analytic memo**
21:38-23:05 Do you feel your understanding of math--your math knowledge, has improved this year?---	Yes, I think again, this is kind of redundant but one of my parts is really just kind of that flexibility with numbers, so **when I go about in seeing math and solving math things I so don't do it how I used to do it.** and it makes so much more sense of like how I can take numbers apart and put them back together to make it really easy for me to solve these math problems. I think another thing is with operations, the operations of math and before, in my past, it was really just I memorize these operations but I had no clue why--I mean I'm sure when I was in algebra I was applying the operations but it was more so something I had to memorize, like the different properties of math so more so to the properties and operations. and **so now even looking at factswise** which is something very basic, as far as skills knowing my facts, or the kids knowing their facts, so that's 3rd grade standard, but then **being able to weave in the properties of operations that they are using for these basic facts. and it coming more natural to me**	MC (content knowledge/ curriculum)	Heather reflects on how her math knowledge and engaging in math processes has improved this year—able to connect properties of operation with math facts when teaching students

Question & Time Stamp	**Transcript segment**	**Code**	**Analytic memo**
11:58-13:56	Now is much more planned out, and thoughtful--like I said before, I thought my kids were more better last	Pedagogy	Mia reflects on the changes in practices

How have the ways you are teaching math now differed from what you did before?	year and it was a lot more random, I don't know if I believe that now, after doing all this stuff, I think that's changed a bit because we're pretty strong in math now and we're getting to these things, **I think maybe I just wasn't asking the right questions**--last year I was just oh let's try this I think they can do it, whereas this year it's more methodical, alright we are going to wait and then ask these questions--**spending more time in analyzing data and looking at word problems and thinking about where to go next--and share outs are now more thoughtful and planned out**		that she has made in regards to teaching—she finds that they are more purposeful—questions and ways lessons are structured are informed by student data.

Question & Time Stamp	**Transcript segment**	**Code**	**Analytic memo**
17:05-19:01 Do you think that there are some expectations coming from the PD that you find to be difficult or challenging to meet?	You know how there are times when you sit in something and you're like 'oh that's a great idea, but we could never do that here.'--I want to say...**I don't have enough time to put it into practice--having trouble connecting what's in PD into the classroom**---like for example that last time we had that rubric (if you are questioning the kids, level 1, 2, 3)--this rubric was amazing, and then after this PD we had the powerpoint where it showed the teachers and how confident teachers felt with monitoring and questioning and shareout--but **I haven't had the chance to talk to the teachers who felt great about monitoring and the tips that they had**--I'm assuming the expectations is for teachers to find some time to figure out why is monitoring so hard and what can you do--but I haven't had that time	PD	Lucy reflects on not having enough time to put what is learned in PD into practice--having trouble connecting what's in PD into the classroom--Ex. During PD saw powerpoint of other teachers' confidence in monitoring, but never got a chance to discuss with other teachers how they are doing that

Question & Time Stamp	**Transcript segment**	**Code**	**Analytic memo**
39:47-40:25 Math train--where are you now on that math train?	so I think I told you before that I thought it was Heather driving the train but I revised that, now **Heather drives the train for our 5th grade planning, she's definitely the conductor there**, like 'alright guys we're going to do this, we're going to do that' and that feels really good cause she has that strong presence, and everyone helps, everyone works.	Perception of others	Claire perceives her co-teacher as the “driver” of the math planning train—she takes the reins and leads the group

The overall goal of this analysis was not to generate a frequency count, but to develop an overall understanding of each teacher’s view and perception within these established categories.

Following the analysis of each interview, I looked across the analytic memos to create summaries for each category.

Mathematics teacher identity construction. To identify and characterize the mathematics teacher identities that emerged from the teachers, I combined the analysis from all three data sources. I wrote up a detailed summary for each teacher that characterized their particular views and perspectives in regards to mathematics, pedagogy, and professional development. The detailed summary served to triangulate all three data sources to generate an overall "snapshot" of these teachers, in essence, a teacher portrait. Moreover, I created a data matrix (Miles, Huberman, & Saldana, 2014) that included a summary for each teacher in relation to their views and perspectives regarding mathematics, pedagogy, and professional development collected from all three data sources as a way to cross-compare the teachers to identify similarities and differences among teachers in perspectives.

I conducted a cross-case comparison on each of the categories among the teachers. Through this analysis, similarities and differences in teacher views for particular categories emerged. The noteworthy differences in each category were highlighted and characterized to establish two mathematics teacher identities that reflected the teachers within this study. The two different mathematics teacher identity types were developed and characterized along two ends of a spectrum: *active* versus *passive.* I placed teachers on opposite ends of the spectrum based on the similarities and differences in their views and perspectives within the three established categories-- thus being characterized as currently constructing an *active* or a *passive* ambitious mathematics teacher identity. Furthermore, I conducted a cross –case comparison among the teachers that were grouped together as being one type. Through this analysis, variation within the group was revealed as well. For example, within the category associated with views on

professional development, I found variations related to teacher investment and commitment towards professional development. These variations led to the generation of a range along the spectrum—on one end I characterized as being fully invested and committed, whereas, the other end was associated with teachers not as invested in professional development. For example, being highly invested in PD, even searching for PD opportunities *outside* of what the school offered, and being committed and invested in the PD opportunities provided at school, to not being invested and committed towards PD that was offered *at* the school. I then placed teachers along a spectrum, some closer to one end of the spectrum based on the within group variations that emerged.

I characterized all teachers to be constructing an ambitious mathematics teacher identity, as reflected by their positive views on reformed-based practices and their participation in school-wide PD. However, differences in teachers' views, commitments and engagement with professional development, and expressed ideologies concerning mathematics were what led some teachers to be identified as constructing an *active* versus a *passive* ambitious mathematics teacher identity.

Sub-question two: What are the different types of tensions experienced by teachers of varied mathematics teacher identities?

To explore the tensions that arose for teachers in the context of mathematics professional development, I drew on two data sources: Post-observation Follow-up Interviews (3 per teacher/ 21 total) and Post-PD questionnaire. In the following section, I explain the analysis process for each data source.

Post-observation follow-up interviews. The analysis of the interview involved three phases. The first phase involved open-coding of tensions that teachers shared and described in

the interview. A tension was defined as being a conflict, dilemma, or a source of frustration for the teacher, essentially, anything that caused teachers to feel not at ease or what which they felt conflicted. I wrote an analytic memo each time a teacher commented or reflected on a tension. I summarized the tensions they shared at the end of each interview analysis. For the second phase of analysis, I drew from research on teacher tensions to help frame the organization of tensions (Barab, Barnett, & Squire, 2002; Beach & Pearson, 1998; Pillen, Beijaard, den Brok, 2013; Smagorinsky, Cook, Moore, Jackson, & Fry, 2004). Table 3.2 depicts the categories that I used in the analysis of teacher tensions with a general description of the tensions as well. These categories were informed by previous research and the results from the first phase of open-coding.

Table 3.4

Categories and general descriptions of teacher tensions

Category	General description of tensions
Interpersonal relationships	Issues and conflict experienced with others (i.e., grade level team, members, principal)
Student Learning	Student learning outcomes—meeting learning goals, proficiency levels
Teacher self-efficacy	Level of confidence regarding role and impact as a teacher
Mathematics professional development	Issues with PD content PD implementation PLC participation
Institutional factors	Leadership roles Direction school is heading

The third phase of analysis involved identifying potential patterns that emerged between mathematics teacher identity types and experiences of particular tensions. Teacher names and their corresponding mathematics teacher identity type were connected to the category of tensions that each teacher experienced. For example, if a teacher experienced interpersonal relationship

tensions, I then recorded her name and corresponding mathematics teacher identity type within that particular category.

Post-PD questionnaire. I utilized a content analysis approach to specify the tensions that teachers shared on the post-PD questionnaire. I sorted each questionnaire based on grade level and session date. I then organized all written responses on a data matrix that included all teachers and their written responses to each question. The data matrix afforded a cross-case comparison analysis of the types of tensions shared by teachers. I then compared the tensions that emerged from the post-PD questionnaire and combined them within the tension categories that I established in the analysis of tensions from the Post-observation Follow-up Interviews.

Sub-question three: How do teachers of different identity types negotiate those tensions?

To describe the different approaches that teachers took to negotiate the tensions they experienced, I drew on two data sources: Post-observation Follow-up Interviews and Post-PD questionnaire. In the following section, I explain the analysis process for each data source.

Post-observation follow-up interviews. The analysis of the different approaches teachers took to negotiate the tensions that emerged involved going back and reviewing the segments within the interviews where teachers reflected on tensions and their corresponding negotiation approaches. I wrote analytic memos regarding how teachers expressed the ways and approaches they had taken to alleviate and negotiate the particular tension. For each teacher, I created a running record of the tension that was shared and the negotiation approach associated with resolving that particular tension. Table 3.5 provides an example of this method of organization and analysis for one teacher, Heather.

Table 3.5

Analysis of tension and negotiations

Heather	
Tension	**Negotiation**
Too much time spent on math planning—takes away time from other areas (PD)	Make suggestions to how they can structure PLC meetings to make it more efficient
Structure of PLC meeting is sometimes not efficient—spending so much time but not completing things— Which curriculum to use?--sometimes too much time explaining things (coach having them going too deep into things (PD)	Voicing concerns with team—coming up with a plan together--Talk with team: Can talk to Lucy about any tensions—talk with Claire
Meeting the needs for each student in her class SBAC—are students prepared? (student learning)	Conversations with PD Facilitator—pick each others' brains—because she is privy to many groups at school, she has internal insights—have more of a perspective than others Overall: If just to vent—go to Lucy--If experiencing push back or questioning something—go to principal directly—"veteran" status, founding teacher at the school—looked upon as a leader in the school
Analytic Memo	
When experiencing tension, Heather feels comfortable with talking directly with team members—Lucy is go to person. She is also very comfortable with approaching the principal and PD facilitator with any issues. Heather is able to have more open conversations because involved in many different groups. Her position within the school community influences	

I conducted a cross-case comparison analysis to look for similarities and differences in the ways teachers negotiated tensions. Lastly, I compared the corresponding teacher mathematics identity types with the types of tensions and negotiation approaches that teachers took to identify patterns.

Post-PD questionnaires. The post-PD questionnaire specifically asked for teachers to reflect on any tensions they experienced or were currently experiencing. This question was followed by asking teachers to comment on the approaches they have taken or will take to negotiate the tension identified. I utilized the same approach that I took to identify the tensions in the previous analysis. I organized the negotiation approaches associated with the tension for each teacher. I added onto the data matrix that was previously generated in the analysis of teacher tensions. Lastly, I compared the tensions and negotiation approaches that emerged from the post-PD questionnaire with those identified in the analysis of the Post-observation Follow-up Interviews.

Data Analysis of Research Question Two

Research question two and sub-questions: What is the relationship between mathematics teacher identities and teachers' participation in professional development? What are the dimensions of competence that are embodied by grade level communities? What role does mathematics teacher identity have on teachers' participation in new communities of practice?

I used both an interpretative and thematic approach (Creswell, 2007) in the analysis of research question two. Analyses for research question two involved the analysis between two data sources: Professional Learning Community (PLC) meeting observation notes/and video and Post-observation Follow-up teacher interviews. In the following sections, I break down research question two and provide a description of how I analyzed each data source to address each sub-question.

What are the dimensions of competence that are embodied by grade level communities?

Wenger's (1998) social theory of learning posits that it is through the process of learning and the engagement in the social practices within a community where individuals become who

they are—process of *belonging* and *becoming* a member of a community (Hodges & Cady, 2012; Nasir & Hand, 2006). Furthermore, Van Zoest and Bohl (2005) find that the goals of a community and the community's participating members "affects how a person's identity plays out in the community" (p. 388). Based on these ideas, the goal of analyzing the PLC meeting observation field notes/and video was to generate an overall understanding of how the community (PLC) functioned as a whole, how teachers participated in the community. More specifically I analyzed the particular social practices and modes of participation utilized by the grade level group. In order to do so, I needed to establish and explore the dimensions of competence connected to each grade level community.

I first reviewed all the observation field notes for each of the PLC meeting in grades kindergarten and 5th (35 & 34 respectively) to acquire an overall sense of how each meeting was facilitated, how teachers participated in the meetings, and the content for each meeting (topics and tasks that teachers were engaged in). I then identified the PLC meetings that were more noteworthy for further in-depth analysis. In particular, I focused on identifying PLC meetings where many opportunities for teacher interaction were present such as: teacher collaboration, opportunities for active learning, collegial colleagueship, and moments where teacher tension and frustration were observable. I focused on these particular learning spaces because during these particular moments, teacher interactions and participation in the community could be more clearly observed and analyzed. Moreover, when teachers engaged in these learning spaces and experiences, they were potentially experiencing tensions and therefore perhaps engaged in the process of reconciling and negotiating new ideas with their existing schemas (Desimone, 2009; Lord, 1994; Loucks-Horsley & Matsumoto, 1999). Within these spaces, I was better able to

gauge different components of the dimensions of competence (i.e., mutuality of engagement, accountability to an enterprise) for each grade level community.

Through this process, I identified 21 kindergarten PLC meetings and 20 5th grade PLC meetings. In an effort to be sure that the meetings were evenly dispersed within the academic school year and that the months in between the school-wide PD sessions were represented, especially the months between the PD sessions that were found to be particularly impactful to the teachers because they had referred to them during their interviews, I created a timeline of the school-wide PD sessions (which included a summary for each session) that occurred during the academic school year (11 sessions + three summer sessions) and mapped the identified PLC meetings dates along the time line. Table 3.6 provides an example of the process that I used to ensure that the selected PLC meetings were evenly distributed between the school-wide PD sessions and within the academic school year.

Table 3.6

Example of organization process of identified PLC meetings

Nov 28, 2015—PD Session : Review 5 practices--use case study example to unpack evidence of 5 practices to orchestrate productive discussions--evaluate learning goals of the tasks--teachers are given a 'planning guide chart' handout to help with grade level planning--teachers work together to create a 'monitoring tool'	
Kindergarten PLC meetings	Fifth Grade PLC meetings
1/5/16, 1/7/16, 1/26/16, 1/28/16	1/5/2016, 1/7/16, 1/12/16, 1/14/16
Jan 8, 2016—PD sessions: Levels of classroom discourse/task--monitoring/anticipating form (Abigail and Lisa facilitate)--teachers watch video of teacher and try to unpack the level of discourse that is present--they discuss the scores, and they share out loud--purpose is to establish norm scoring amongst the group---teachers are then given a task--, choose an everyday math task, or another math activity planned, and come up with a learning goal, and anticipate on what students will do—fill out the form—and share with principal---you will do the task within the next week and use the monitoring form, and will bring all the student work with you to the next PD	
Kindergarten PLC meetings	Fifth Grade PLC meetings
2/2/16, 2/8/16, 2/23/16	2/4/2016, 2/11/16, 2/23/16, 2/25/16
Feb 24, 2016—PD Session: "fishbowl" unit planning with Sara" grade level representatives in attendance only--PD is on demonstrating the process of unit planning—Sara guides 5th grade team on the process of unit planning--going through the steps and which resources to read through--lots of discussion on time	

investment--principal mentions he would be willing to support them in this process (i.e., giving them a whole day to plan)-group also discusses adjustments they would like to make to the planning process draft--	
Kindergarten PLC meetings	Fifth Grade PLC meetings
2/25/16, 3/1/16, 3/3/16, 3/8/16, 3/10/16, 3/15/16, 3/21/16 (full day planning)	3/1/2016, 3/8/16, 3/10/16, 3/17/16, 3/24/16 (full day planning)

I utilized Wenger's three dimensions of competence: mutuality of engagement, accountability to an enterprise, and negotiability of a repertoire to explore group dynamics within a grade level community (1998, 2008).These dimensions and corresponding definitions were drawn directly from Wenger (1998, 2008) (see Table 3.7). I applied these dimensions of competence within each grade level community to help guide the analysis of my observation field notes.

Table 3.7

Wenger's three dimensions of competence (1998, 2008)

Dimension	Description
Mutuality of Engagement	Certain expectations about how to interact, certain ways of engaging in actions with other people, how to work together. Involves behaving in expected ways for someone in a given community
Accountability to an Enterprise	Set of communal standards (explicit/implicit) for performance and interaction that develops within and is sustained by a community regarding its work— Community's regime of accountability serve to regulate peoples' activities by providing criteria and systems for their evaluations The forms of accountability through which individual's contribute to that enterprise influences perception of the world in certain ways.—engage in certain actions, make certain choices, value certain experiences
Negotiability of Repertoire	Requires participation in, and ownership of, a community's regime of experience. When individuals join an ongoing community, they engage in both using their personal experience to better the community and in adjusting their own experience to the regime of experience of the community---sustained engagement in practice yields an ability to interpret and make use of the repertoire of that practice Negotiability of long-established and developing regimes of experiences.

I framed my analysis of the professional learning community by describing how each of the dimensions of competence was embedded in the social practices of each grade level community. I reviewed each of the identified PLC meeting observation field notes in conjunction with the video recordings of the meeting. The video recordings afforded the ability to hone in on particular teacher discussions and conversations when observation notes were unable to capture all teacher dialogue in its entirety.

For each PLC observation field notes and video analysis, I wrote analytic memos and highlighted particular segments or discussions that reflected components related to how the community mutually engaged with each other, their perceived accountability to an enterprise, and the ways they negotiated repertoire of practices or ideas. I also focused the analysis on two teachers in particular, Laura (Kinder) and Claire (5^{th}), both novice teachers to a new grade level community and identified as cultivating an *active* ambitious mathematics teacher identity. Claire was part of a community where its members took on a mathematics teacher identity similar to hers, whereas, Laura brought her *active* ambitious mathematics teacher identity into a community where its members reflected *passive* ambitious mathematics teacher identities. I wrote analytic memos on their participation and interactions with others in their respective grade level community. I then drew from my analytic memos and wrote an overall summary of what took place during each meeting. I created a chart to help organize the analysis of each PLC meeting and drew from the analytic memos and placed them within the following categorical bins (see Table 3.8).

Table 3.8

Organization of PLC observation field notes/video analysis

Overall PLC meeting summary: 1/5/2016--Group is working on designing post-test assessments--going through the standards and making sure that the "look fors" are accounted for—when Claire has questions she asks Heather for clarifications--teachers are really focused in their discussions regarding coming up with problems that are aligned with the standards--Central task: Teachers are creating problems that are linked with particular standards	
Categorical Bins	**Example of descriptions (drawn from analytic memos)**
Active learning (e.g. making practice visible, taking action to improve practice)—	in coming up with a problem, teachers would make their thinking visible by writing it on the board, and discussion would be around what they would be asking the students--context, representation, numbers, area--they unpack what affordances that problem offers and what type of problem solving it requires of students and if that is aligned with the standard
Collective participation (e.g. providing constructive feedback to colleagues and collaboration with colleagues),	Each teacher contributes to the discussion in coming up with a problem--all voices are heard--Coach shares her concerns about problem, group then discusses--collectively even come up with numbers to use in the problem and what makes sense more
Critical colleagueship (e.g. critical self-reflection, sustaining productive tensions)	teachers go back and forth about the problem solving--lively discussion when ideas are different, teachers explain their thinking--particulars of units and context--representing with area model or if students can find area and multiply--teachers go back to the standards
Mutuality of Engagement	Heather really takes the lead with coach--Claire at times would ask for clarification regarding a particular standard--what's considered 4th grade and 5th grade standard--what is a precursor
Accountability to an Enterprise	working together in filling out the planning document--standards, "look fors", problems
Negotiability of Repertoire	relates it back to SBAC to show how certain problems are designed--"on SBAC they do need to know…."--go back to reading standards to show what the problem should be addressing--not asking for area model--
Notes	mutual engagement, collective participation, accountable to enterprise--very robust discussions in generating a problem for post-test, making sure it is assessing the standards they want to assess--all teachers contribute--they are able to bring their ideas to the table, counter other teacher's ideas, and then come to an agreement

I first analyzed each PLC meeting observation field notes individually followed by a cross-meeting analysis (Miles & Huberman, 1994). I utilized a cross-meeting analysis to generate an overall understanding of the particular dimensions of competence-- mutuality of engagement, accountability to an enterprise, and negotiability of repertoire—embodied by the grade level community. I engaged in the same analysis process for kindergarten and 5th grade community. As a way to confirm the claims made based on observations, I wanted to be sure that my

observations were aligned with the perceptions and experiences of the teachers within the community. Therefore, I went back to the teacher Post-observation Follow-up interviews and analyzed teacher perspectives in relation to the community—perceptions of others, perception of community goals, perception of working with others. Lastly, I compared the analysis of teacher perspectives with the analysis of the observation field notes/videos to finalize the findings. For example, through the analysis of observation field notes, findings revealed that within the kindergarten community there appeared to be differing viewpoints regarding the "enterprise" they felt accountable to. Based on this finding, I went back to the teacher Post-observation Follow-up interviews to confirm whether or not teachers had different perceptions regarding which "enterprise" they perceived to be accountable to.

What role does mathematics teacher identity have on new teachers' participation in new communities of practice?

For the second phase of analysis, I selected two teachers to highlight their particular experiences as novice teachers who were also transitioning into a new grade level community. I focused, in particular, on each of their unique experiences becoming members of a new community and thus developing the dimensions of competence respective to their professional learning community. The goal was to understand how their mathematics teacher identities influenced their experiences participating in the community with teachers of similar and different mathematics identity types. In addition to analyzing their participation and interactions with others during PLC meetings, I also analyzed their Post-observation Follow-up interviews to gain a firsthand account of their perceptions regarding their own learning experiences with developing competence in regards to knowing how to participate as a new member in each of their

respective grade level communities. This analysis served to substantiate the observational findings regarding their participation and interactions with others during the PLC meetings.

PLC observation field notes and video recording. To analyze Laura and Claire's particular experiences within their respective PLC, I went back to the observation field notes for each grade level separately. I first analyzed Laura's experience with the kindergarten community. I revisited the observation field notes and video recordings pertaining to the kindergarten PLC meetings and focused my analysis on the segments and discussion points that included Laura. I added to the organization chart that was previously created to analyze the dimensions of competence and included a separate category that only pertained to Laura's experience with developing the dimensions of competence in mutuality of engagement, accountability to an enterprise, and negotiability of a repertoire. I then cross compared the findings particular to Laura to the findings particular to the whole community. I engaged in this process of analysis for Claire, in Fifth grade, as well.

Post-observation follow-up interviews. Once I analyzed the observation field notes/videos and included the overall findings on the organization chart, I went back to the Post-observation Follow-up Interviews particular to Laura and Claire. Similar to the process conducted previously, as a way to substantiate the findings based on the observations, I wanted to be sure that my observations were aligned with Laura and Claire's own perceptions regarding their experiences and others in the community. I went back to each of their respective post-observation Follow-up Interviews, separately, and analyzed their perceptions in relation to the Community--such as others' perception of self, perception of others, and own perceptions of others' perceptions (Van Zoest & Bohl, 2005). Moreover, I also analyzed their responses in relation to interview questions that gauged their perceptions regarding community goals

(position on the "train"), working with others in their PLC, and learning the practices of the new community (dimensions of competence). I analyzed each of the interview responses and focused on the segments that included teacher responses related to the previously discussed perceptions related to Community. Table 3.9 provides an example of this analysis process.

Table 3.9

Analysis of Post-observation Follow-up Interviews—Focus on Community

Question & Time Stamp	Transcript segment	Code	Analytic memo
39:47-40:25 Math train--where are you now on that math train?	so I think I told you before that I thought it was Heather driving the train but I revised that, now **Heather drives the train for our 5th grade planning, she's definitely the conductor there**, like 'alright guys we're going to do this, we're going to do that' and that feels really good cause she has that strong presence, and everyone helps, everyone works.	Perception of others	Claire perceives her co-teacher as the "driver" of the math planning train—she takes the reins and leads the group

Question & Time Stamp	Transcript segment	Code	Analytic memo
54:03-57:18 In terms of coming into a team, coming into a community, how do you become a part of that community?	I think **I asked questions sometimes to kind of understand people to help settle my mind**—this is going to sound weird, but sometimes I can be kind of funny, like I can make little jokes--I don't know, I think people appreciate that sometimes (laughs) I don't know..what did I try to do?--I just kept doing the **best that I could with everything, with my interactions, with trying to be helpful, trying to be flexible** and--I think it's just been a **process where you just get to know people and they get to know you** and it wasn't like I had any kind of strategy or anything, it was just**--I genuinely felt welcomed and I was genuinely happy to be part of this team** and it felt really good and that just kind of built, like just these positive things built	Community	Claire reflects on her process in becoming a member of a new community—being helpful and flexible-- she felt very welcomed by her co-teachers in the community.

I then summarized and compared the findings of Laura's and Claire's interview responses with the findings of the observation field notes/videos in order to characterize the relationship and differences in experiences and perceptions between each of the teachers and their communities.

The overall goal of this analysis was to develop an overall understanding regarding Laura and Claire's perception of others in their PLC and also their perceptions regarding their own participation and experiences with engaging in the practices of a new community (dimensions of competence) as they worked towards becoming members of a new community.

To ensure the trustworthiness of my data analysis, I periodically shared with a qualitative research lab group the analyses and the emerging patterns and findings that I came across in the process. Additionally, I also made efforts to substantiate my findings by triangulating the data. I also member checked with the PD designer/facilitator to ensure that I had accurately described the goals of the professional development as it was intended.

CHAPTER 4

Research Question One Findings

The purpose of this analysis was to deconstruct the construct of mathematics teacher identity and explore the relationship between mathematics teacher identities and teachers' experiences of tensions and negotiations in the context of professional development. In this section, I introduce a conceptualized spectrum linear model (Miles, Huberman, & Saldana, 2013) to represent a range between two developing mathematics identity types that emerged from this study—*Active* ambitious mathematics teacher identity and *Passive* ambitious mathematics teacher identity.

A spectrum linear model provides a continuum structure that provides a pictorial representation of variations that exist between the two mathematics teacher identity types: *Active* and *Passive.* Within this range, variations in perspectives also exist amongst teachers. This spectrum model helps to illustrate the idea that teachers are cultivating their mathematics teacher identities as they engage in teaching and professional development and that teacher's mathematics identities should not be exclusively identified as being one permanent type. In the context of this study, the spectrum linear model represents the mathematics teacher identities of teachers at a particular point in time and does not reflect a permanent identity placement for these teachers. The use of a spectrum linear model is based on the theoretical perspective that identity is not static and unchanging, but is rather influenced and molded through the social process of learning within a particular community (Flores & Day, 2006; Wenger, 1998; Wenger-Trayner, 2015). The social process of learning and the negotiation and adjustment of conflicting ideas that takes place within the learning community will allow for further identity formation (Alsup, 2006; Smagorinsky, Cook, Moore, Jackson, & Fry, 2004; Wenger, 1998). This

conceptualized model introduces two mathematics teacher identities that fall on opposite ends of the spectrum. Teachers in this study are identified as falling along this spectrum, some situated closer towards one end versus the other.

In addition, I also describe teachers' experiences of tensions and negotiations in relation to their mathematics teacher identity types. The findings revealed that as teachers were situated within a professional development that was designed to promote a vision of *ambitious* mathematics teaching, differences arose between how tensions were negotiated. Findings revealed that aspects of *self-in- community*—their perception of their *roles* and the *roles of others* in the community—had a particularly strong influence in regards to how teachers sought out assistance with negotiating tensions experienced.

This analysis was grounded within the mathematics teacher identity framework proposed by Van Zoest and Bohl (2005) for the study of mathematics teacher identity as presented in chapter 2 (refer to Figure 2.1). The framework highlights different components in the study of mathematics teacher identity development, where *aspects of self-in-mind* and *aspects of self-in-community* come together (van Zoest & Bohl, 2005). To study the relationship between mathematics teacher identity and teachers' experiences of tensions and negotiations in the context of professional development, I focused on particular aspects of the framework separately and then in relation to each other.

To answer the first research question I will present the findings in three parts. Part I presents a conceptualized spectrum linear model of mathematics teacher identities that represents the teachers in this study (*aspects of self-in-mind*), followed by Part II, where I describe different types of tensions teachers experienced in the context of professional development (*aspects of self-in-community*). Lastly, in Part III, I share the findings on the relationship between

mathematics teacher identities and the negotiation of tensions (relationship between *aspects of self-in-mind* & *aspects of self-in-community).*

Part I Variations in Mathematics Teacher Identities

Ambitious mathematics teacher identity spectrum. Data analysis revealed that as teachers engaged in professional development in the context of mathematics over the course of a school year, their emerging mathematics teacher identities had an influence on how they experienced and negotiated tensions. I constructed a spectrum linear model to represent the mathematics teacher identities that reflect the variation among the teachers in this study. This model introduces two types of mathematics teacher identities that fall on opposite ends of a spectrum: *Active* ambitious mathematics teacher identity and *Passive* ambitious mathematics teacher identity (see Figure 4.1).

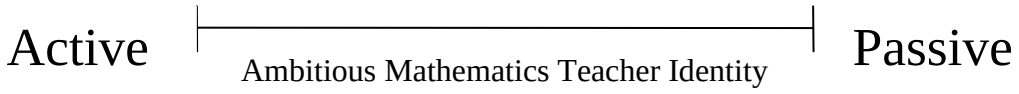


Figure 4.1 *Mathematics Teacher Identity Spectrum in the Context of Math PD*

The teachers' mathematics teaching identities were identified within the range of these two ends, some closer to one type as opposed to the other. Bounded within a school system that was in the process of promoting *ambitious/*reform-based practices, such as Cognitively Guided Instruction (Carpenter, Fennema, Franke, Levi, & Empson, 1999; Stein & Smith, 2011)—all teachers were in the process of acclimating themselves with this vision of teaching—however, variations were found regarding teacher perspectives and views on mathematics and engagement with professional development, in particular. Only slight differences were identified with regards to their views on pedagogy. Table 4.1 provides a description of characteristics that exemplified the two mathematics teacher identity types.

Table 4.1

Mathematics teacher identity type and descriptions

	Description of examples of characteristics	
	ACTIVE Ambitious mathematics teacher identity	***PASSIVE*** Ambitious mathematics teacher identity
Views on math	Broader concept of the importance of math learning (math is everywhere, critical thinking, need math to function in society, positive disposition towards math)	Refers more to the usability and applicability of math—balancing checkbook, buying groceries, paying taxes
Views on pedagogy	Perceives CGI practices in positive light Proactive in improving practices (articles, books, teaching videos, internet) Continuous learning,	Perceives CGI practices in positive light Lack of knowledge and expertise limits engagement in reformed-based practices
Views on PD	Invested in math learning and committed to math professional development Seeks opportunities to learn (conference attendance, networking with other educators) Flexible Willing to make changes	Not as invested in and committed to math professional development Not receptive/reluctant to change/inflexible Passive learning--does what is expected--go with the flow—despite not being 'onboard'

A cross-case analysis revealed that teachers aligned more with the characteristics of one identity type as compared to the other---*active* versus *passive.* More specifically, the model showed four teachers who reflected more of an *active* ambitious mathematics teacher identity and three teachers who reflected more of a *passive* ambitious mathematics teacher identity (as seen in Figure 4.3).

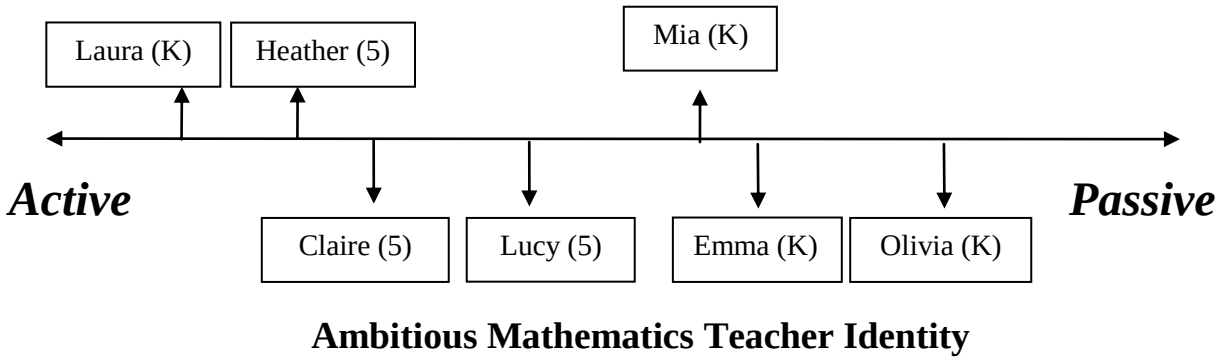


Figure 4.3 *Teachers' Ambitious Mathematics Teacher Identity Spectrum*

In the next section I explain the two identity types that emerged from this study and their corresponding characteristics.

Active Ambitious Mathematics Identity

Views and perceptions of mathematics. Teachers characterized as developing a more *active* mathematics identity held views and perceptions of mathematics that were more attuned and aligned with the vision of ambitious mathematics teaching. Teachers tend to have a broader concept of the importance of mathematics, in particular, viewing mathematics as not just bounded within the walls of a classroom, but as being a critical skill and component to have in order to function in society. This was most evident in the way they explained why mathematics was important. Laura and Heather, in particular, viewed mathematics as an essential piece to develop the mind and function in society. Laura expressed that "Math enriches who you are… when you practice that sense making it enriches who you are—I generally think it is crucial to like your development…to be able to make, practice that sense making" (Life Story interview, 10/26/15). Heather also expressed similar sentiments, **"**[math is important] for a lot of reasons. One for just the basic being able to function in society…you have to have mathematical skills" Life Story interview, 11/5/15).

Claire and Lucy also expressed similar viewpoints regarding the importance of learning mathematics. Lucy perceived math as important because it is "everywhere" and learning math is important because it is a "brain-trainer." She viewed mathematics and in particular, the skill of decomposing numbers and solving problems to be essential towards the development of the skill to multi-task---a skill she views to be necessary in order to function in society. Claire had a perception that people would be "handicapped" in society if they lacked a strong understanding of mathematics because mathematics was "everywhere." Teachers identified within this range of the spectrum tended to have a more positive disposition towards mathematics learning because they held such views regarding mathematics and therefore recognized the value of promoting a positive attitude towards learning mathematics, building a strong mathematics foundation for their students and for themselves.

Views on pedagogy. Teachers' views and perceptions regarding pedagogy and student learning of mathematics reflected the vision and practices of *ambitious* mathematics teaching. In particular, these teachers recognized the importance of positioning students at the center of instruction and making student thinking visible through student share-outs. They were also aware of the need to continuously develop their pedagogical skills to better elicit, analyze, and respond to student thinking and reasoning. Teachers shared and expressed these particular views during their interviews, Lucy and Laura both shared their views on pedagogical views. During her Post-observation Follow-up Interview in March, Lucy indicated that: "I'm spending more time anticipating for myself and with my group, during PLC meetings, looking at student work more now." Laura also shared her views regarding pedagogical approaches:

> …making connections so like having a problem and then like…its really exciting to see like when students can share out and they have the manipulative and they have the pieces

> that will help support their learning and then they figure out how another person approached the problem...(Laura, Life Story Interview, 10/26/15).

Teachers recognized the importance of attending to learning goals and learning standards when planning lessons and expressed the need to remind themselves to not lose focus of the learning goals when teaching. They spoke in regards to the value of Cognitively Guided Instruction (Carpenter, Fennema, Franke, Levi, & Empson, 1999; Stein & Smith, 2011) — despite experiencing some challenges with implementing this form of teaching, they were aware that there is a learning curve for teachers and that they were still developing and changing their teaching practices. Teachers tended to speak about the benefits of having students engage in problem solving and the learning opportunities that are made possible when students share and articulate their thinking to each other. For example, Claire and Heather both expressed the benefits of these pedagogical practices:

> They need to practice, they need to be able to experience it, I think they actually learn better from hearing other kids', student's ideas sometimes, cause I think, I've noticed, that sometimes a student will rephrase something and there's something about that… I've actually noticed that with the teaching, that sometimes another student talking about something really helps students learn (Claire, Post-observation Follow-up Interview, 3/30/16).

> …the problem solving-utilizing strategies to making sense of things on their own--I think like communication, a lot of the articulation, them discussing, conversing about what they did, why they did it, how they did it. I think that's important as well (Heather, Post-observation Follow-up Interview, 4/1/16).

Laura and Heather, in particular, voiced the need of support in facilitating productive discussions effectively. They recognized their role as a facilitator during classroom discussions and that the types of questions they asked students would impact student learning. Laura and Heather were very much aware of the importance of eliciting student thinking and would express the need to develop the necessary skills that would enable them to effectively engage in strategic share-outs with their students. This concern was most evidently expressed by Laura and Heather as compared to Claire and Lucy:

> I would like more support around eliciting student thinking. Like questioning like I would like to learn to ask more powerful questions that would like get the students like involved in the discussion so that I am not talking much (Laura, Post-observation Follow-up Interview, 4/11/16).
>
> …a skill that I really want to work at is really being attuned to listening to each other and asking questions from each other, for them to actually be engaged in listening to someone else's strategy and asking them questions… (Heather, Post-observation Follow-up Interview, 5/31/16).

The pedagogical practices that the teachers worked on and engaged in reflected the vision and practices of ambitious mathematics teaching. Although this vision of teaching was something that was still new to them, they were "onboard" and open towards the idea of adapting and making changes to their practices in order to improve their pedagogy and student learning.

Views on professional development. In addition to having views on mathematics and pedagogy that were more aligned and reflective of ambitious mathematics teaching, some teachers were also *actively* ambitious in regards to their own professional development in the context of mathematics. That is they were more receptive towards the professional development

that was required of them at school. These teachers tended to not only recognize the limitations to their own understandings of reform-based mathematics teaching, but became proactive in finding learning opportunities to better their own mathematical capacity. Therefore, in addition to wanting to teach mathematics *ambitiously,* teachers also had an *active* level of commitment towards their own learning. They were invested and committed to improving their practice and thus were receptive to the professional development that was offered to them. They had a strong growth mindset where they sought out and engaged in opportunities that would help with their teacher professional development. This was most evident in their understandings regarding the goals of the professional development and their engagement in finding resources to help improve their math content knowledge and pedagogical practices (i.e., books, teaching videos). For example, Laura's commitment to her own professional development in mathematics was most evident with her initiative to attend a mathematics conference during the school year. This was noteworthy because Laura volunteered her time after school for the conference to have her attendance fees waived. This exemplified Laura's dedication towards improving her mathematics knowledge. Furthermore, Laura and Heather expressed how they attended educational conferences in the past and sought out opportunities to learn in order to be involved in a larger mathematics community. They referenced their use of Twitter as a way to stay connected with research and other educators. Heather shared her use of Twitter: "You know I use Twitter and just to connect with educationally—like Twitter is awesome for education…I don't do it for personal or to keep up with pop culture, I just do it for education…"(Post-observation Follow-up Interview, 5/31/16). Laura shared how she used twitter as a networking space:

> It meant that I went to other conferences, I started networking with people. I am on twitter in a way in that I would have never because I was never a Twitter person…this

> could be a space for networking. Those kinds of things I feel really helped me to broaden my vision of education… (Laura, Post-observation Follow-up Interview, 5/26/16).

Teachers who fell along the *active* range of the spectrum exemplified a form of appreciation for professional development and their level of engagement towards professional development varied. Laura's initiative towards professional development was one step further than Heather, Claire, and Lucy in that she would actively seek out opportunities on her own time and money and expressed how "privileged" teachers were to have the opportunity to learn. Heather's interest in wanting to learn and improve her mathematical understandings contributed to her positive disposition towards the need for professional development and she referenced past conference attendances:

> I think the other thing is like I'm always like looking to, I want more opportunities, because the more I put myself out there in this other math community…the more that I'm participating in that as kind of a student, the stronger my understanding becomes, and I feel like that's an area that I really want to focus on (Heather, Post-observation Follow-up Interview, 4/1/16).

As a novice teacher Claire sought resources such as teaching video channels or online resources to help with her planning of mathematics lessons and to help develop her mathematical content knowledge. Lucy's level of engagement with professional development was always positive but due to personal circumstances she was less fervent in regards to seeking out professional development that was not required by the school. Although all teachers expressed positivity and commitment towards professional development, there were variations with respect to their initiative and engagement in professional development that was not required of them. This variation accounted for their placement along the *active* range of the spectrum.

This group of teachers was considered to be *actively* and *ambitiously* working towards developing their practices and content knowledge. They recognized the importance and need to be continuously developing their content knowledge and improving their teaching practices. Thus, they saw the value of the professional development and were committed and invested.

In the next section, I explain the characteristics of a *passive* ambitious mathematics teacher identity and elaborate on the variation among the three teachers who fell within this end of the spectrum.

Passive Ambitious Mathematics Teacher Identity

Views and perceptions on mathematics. Teachers who were situated toward the *passive* end of the spectrum tended to view and talk about mathematics bounded within a classroom. They elaborated more in regards to the usability of mathematics in more practical terms such as the importance of developing number sense, knowing how to add, telling time, grouping students, etc. They tended to convey the importance of mathematics learning as it pertained to the practicality of using mathematics in daily life and in the classroom. Their explanations included sharing more life-applicable examples: "…because math is in everything, everyday, all the time—at the grocery store, taxes, figuring out student groupings" (Olivia, Post-observation Follow-up Interview, 2/3/16). Emma also expressed a similar view regarding the practicality of using mathematics: "It is a very important thing…you need to be able to balance a checkbook and you need to be able to understand your finances…" (Life Story interview, 11/17/15). Teachers' perceptions regarding the importance of learning mathematics focused more on the applicability of mathematics to daily life. Using examples as it applied to their own daily lives as an individual, focusing more on its practicability and less in regards to how it relates to crucial developmental skills. However, Mia's views and perception on the importance of mathematics

learning differed from Emma and Olivia because she veered from focusing more on the application of mathematics in solving problems:

> …I'm thinking, "I use math every single day." It really is. And I think it's not just math now that we're teaching. It's, like, "Oh, yeah. You don't need to know addition, but how did you get there?" It's all the steps, the process of solving math problems. I think that's the most important. The steps that you learn to think critically, to unpack problems, to really try and get to what the solution is and the way you get there. I think is – I don't care – I don't care if you get that 2+2 is 5…Sure. Why not? But how did you get there (Mia, Life Story interview, 12/15/15)?

Mia's views on the importance of learning mathematics focused on the skills that are developed in the process of solving problems. Mia viewed the importance of learning math as not just being because able to add numbers and get a solution, but rather the ability to critically think, unpack problems, and articulate the thinking process. These viewpoints differed from Emma and Olivia, thus situating her placement on the spectrum closer towards the center.

Views on pedagogy. Teachers expressed their viewpoints and perceptions on the value of engaging in practices that were reflective of ambitious mathematics. Their familiarity with reform-based instruction was attributed to school-wide efforts of providing professional development and training to prepare teachers to teach mathematics using Cognitively Guided Instruction for the past few years. Teachers spoke in regards to the value of teaching mathematics through the use of manipulatives and hands-on activities. For example, Olivia expressed: "Anything where they are like physically holding things or moving things, manipulating them, and having to…probably that's the way I'd say…working with partners with manipulatives would be the best way for kindergarteners" (Life Story Interview, 10/29/15).

Teachers also emphasized the importance of teaching mathematics using the approach of moving from concrete to representational to abstract as being conducive towards students learning mathematics. Furthermore, they recognized the importance of context when creating mathematical problems. This was most evident in Olivia's explanation to why context came to matter for her:

> Whenever I can apply it to real-life because like I have mentioned before, to me numbers came easy to me …I could like add them together… I could figure out the problems but I didn't always know what it meant or why I was doing it...and so after becoming a teacher and learning more about Common Core and everything, it just seems like oh there is so much significance because now I've forgotten a lot of math because it didn't have any foundation basically. ...And also seeing at this age too what a difference it makes for so many kids to have a context for something versus just like "alright 2 +3" (Olivia, Post-observation Follow-up Interview, 5/26/16).

Mia and Emma both expressed the value of facilitating opportunities for students to share and articulate their thinking. Mia reflected on the importance of "debriefing" moments during lessons because it is during that space where there is opportunity to gauge student thinking and learning. Emma in particular referred to particular practices such as re-voicing and rephrasing student responses during whole class discussions. She viewed re-voicing and rephrasing student responses as a tool for making student thinking visible and adding on to students' thinking. Mia's positive perceptions regarding Cognitively Guided Instruction stem from her credential and masters program where she learned, studied, and witnessed the impact of cognitively guided instruction on student learning:

> CGI math problems—that was how I was taught, they showed me all the research and data that went with it, and I bought in…and it makes sense…I see my kids progressing…and stuff like share-outs are so meaningful for some of those kids (Mia, Post-observation Follow-up Interview, 4/15/16).

Teachers in this group were cognizant of the impact that *ambitious* mathematics teaching can have on student learning when they took up these practices; however, despite being able to reflect and speak on the importance of such practices, it was evident that their understandings regarding how to take up these practices were still at the emergent stage. They were still in the process of trying to implement these practices in their daily routines and mathematics lessons, less reluctant in taking on new practices that they were not familiar with. Emma preferred engaging in these practices in small groups, working with students one-on-one, rather than embracing these practices whole group. Olivia's emergent understanding regarding the pedagogical practices affiliated with Cognitively Guided Instruction and how to implement this form of teaching with fidelity was most apparent when she shared her reluctance in teaching mathematics due to her lack of understanding of how to scaffold student learning utilizing reform-based practices directed for whole-group instruction: "…a lot of the math now is like…don't tell them anything, just have them do it, and then guide them to the right answer…I don't know how to do that in a group" (Post-observation Follow-up Interview, 2/3/16). She shifted the responsibility of teaching mathematics to her co-teacher:

> So lately [co-teacher] has been teaching math because I'm just like I don't know what to do with this. It's whole class and I can like sit with one kid, but I don't know how to teach you guys all together what to do (Olivia, Post-observation Follow-up Interview, 2/3/16).

Olivia's passivity for learning how to engage in Cognitively Guided Instruction whole-group was reflected by her reluctance to teach mathematics due to her underdeveloped pedagogical skills in reform-based practices. Moreover, when asked if she ever tried to seek out support to improve her pedagogical skills in this area, she said she had not.

As a whole, teachers in this group spoke positively about Cognitively Guided Instruction and could see the value of engaging in *ambitious* mathematics teaching for student learning, however, the variation that existed among the teachers were found to be related to the depth of their understandings regarding the goals of such practices and how to take up these practices consistently and with fidelity in their teaching. This level of understanding influenced the capacity in which they took up the practices within their classrooms and thus reflected a component of their *passive* mathematics teacher identity.

Views on professional development. In contrast to the teachers who were identified as developing an *active* ambitious mathematics teacher identity, teachers in the *passive* range of the spectrum struggled to see the value and relevance of the professional development in relation to their practice and grade level. Both Olivia and Emma expressed similar perspectives: "We have been doing trainings at school but the trainings seem to focus more on older grades. I just don't know how to apply it to kindergarten" (Olivia, Post-observation Follow-up Interview, 2/3/16), "…sometimes I feel like those PDs we're just sitting here…like how am I gearing multiplication to my kindergartners? I'm not…it doesn't link to me" (Emma, Post-observation Follow-up Interview, 2/9/16). Their current priority in professional development was not situated in the context of mathematics and thus they struggled to balance their commitment and investment in the mathematics professional development that was offered to them. Furthermore, they were not "onboard" with the changes that were being asked of them. In particular, they were resistant to

the new process of unit planning that was expected of them because they not only did not see the need to make the changes, but also did not fully understand the goals of the mathematics professional development that was offered which further deterred them from embracing the mathematics professional development:

> For me it's hard that for everything I do it has to have some standard attached to it. I feel like a lot of us, never done this in the past, specifically, but we look at the standards, and we covered it all last year, it was fluid, more flexible and natural, and this year it feels more forced (Mia, Post-observation Follow-up Interview, 2/3/16).

Emma recognized the need to improve her practices; however, she felt the professional development focused too much on content knowledge—and when asked if she felt whether or not her math knowledge improved this year due to her participation in professional development, her response indicated that the structured math planning, which was the central focus during their PLC meetings, was not beneficial towards her professional development because she perceived her understanding of mathematics in kindergarten to be already strong. When asked if she felt her math knowledge had improved, Emma replied:

> I feel like I have been doing kinder for a while and it's been pretty much the same…Maybe that's why I'm saying that I don't really need that this year because I have been teaching kinder for so many years and same standards basically. So I feel like that math planning is beneficial if you're moving to another grade then you're really digging into standards and learning how to teach it (Post-observation Follow-up Interview, 5/26/16).

It is not to say that they did not participate in professional development, but rather that their participation was more as a passive learner, where they attended professional development that

was required but did not describe the learning outcomes as pertinent or useful toward their professional growth.

Teachers tended to be less receptive to change especially when it did not align with their vision. Emma and Mia both voiced their concerns regarding the direction the school was heading, indicating that Project Based Learning (PBL) was being neglected and that there was too much emphasis on mathematics: "Our school is project based learning. It's not a math school" (Emma, Post-observation Follow-up Interview, 5/26/16). Although they did participate in the professional development that was required of them, because of their passiveness and lack of investment in the goals of the professional development, they tended to just do only what was expected and to simply "go with the flow." For example, Mia shared:

> …it's just that we felt really overwhelmed in the beginning--like whenever we had coaches and all these meetings and they told us a lot of stuff, I think some people got defensive--and we're like we've already been doing this and then they ask well where's the data--well, ok fine, we'll write it down for you—I think at first it was a little overwhelming with that stuff— for myself I kind of shut down—and was like "alright...then tell me what to do...sure...I don't know anything…you know...whatever (Mia, Post-observation Follow-up Interview, 2/3/16).

Teachers who fell closer towards this range of the spectrum were considered to be on the *peripheral* point towards being receptive to change and being willing to adapt their views if given the sufficient encouragement and scaffolding. They were comfortable with maintaining the practices they had come to use in their classrooms; they did not necessarily find that they lacked the knowledge to teach mathematics effectively. Thus, while they saw the value of improving their instruction, their passivity was in response to not being able to see the value of the

professional development and the sustainability of what was being asked of them currently. Olivia and Emma, in particular, hesitated to embrace the new changes proposed by the professional development program without being sure that they would continue these practices the next year. For this group, they needed to be convinced to make changes to their practices by seeing the impact, purpose, and sustainability of a new approach before they were committed.

There is great opportunity for substantial learning and change to take place *if* teachers come to see the value of the professional development on their own learning and growth as a math teacher and its impact on their practices and student learning outcomes. Teachers need to be able to identify and recognize the need for improvement in their own mathematics capacities as a teacher in order for changes to be made (Alsup, 2006; Hodges & Cady, 2012). Thus, teachers who have an identity more reflective of a *passive* ambitious mathematics teacher, if professional development is structured in a way where their learning needs are met and they experience productive disequilibrium; there is great potential for teacher learning and change to take place (Lord, 1994).

In the next section, I turn my focus to describing the tensions that the teachers experienced in the context of mathematics professional development as it relates to their mathematics teacher identities.

Part II Tensions

An important feature that supports developing professional identity is the *tension* that is experienced in different communities/context. These tensions can develop as a result of incongruence between teachers' own views of what it means to teach (i.e., values, practices, content knowledge) and what is expected of them (i.e., Common Core standards, professional development) (Beauchamp & Thomas, 2009). "Tension" is defined in this study as situations and

issues that result in teachers experiencing frustration, conflict or issues that cause mental constrain and/or pose as a concern for teachers (i.e., cognitive dissonance). Learning experiences that provoke opportunities for teachers to experience tensions, such as ideological dissonance, or ambiguity become opportunities for identity development (Alsup, 2006). I refer back to the mathematics teacher identity framework by Van Zoest and Bohl (2005) to situate the findings within the interrelated components of *aspects of self-in-mind* with *aspects of self-in-community*. The framework conceptualizes mathematics teacher identity as it is formed in relation to participation in community, and the vehicle for identity development are the negotiation of tensions that arise due to the ideologies that interact between the two components—self and community (refer to Figure 2.1). To explore the tensions that teachers experienced in the context of mathematics professional development, I focus on the relationship between mathematics teacher identities and the types of tensions that were experienced in the professional development community.

Drawing from prior research on tensions experienced by novice teachers (Barab, Barnett, & Squire, 2012; Beach & Pearson, 1998; Pillen, Beijaard, & Brok, 2013), I created preliminary categories of potential tensions that teachers may experience as a basis for scaffolding the analysis of teacher tensions.

Types of Teacher Tensions

Data analysis revealed that teachers experienced many different types of tensions as displayed in Table 4.2.

Table 4.2

Teacher Tensions

Category	Description of Tensions	Teacher mathematics identity
Interpersonal relationships	Conflict amongst grade level team members/co-teachers/conflict with	Laura (active) Emma(passive), Mia (passive)

	students	
Student Learning	Student learning outcomes—concern with reaching all students—preparing them for SBAC	Laura, Heather, Lucy, Claire—(active)
Teacher self-efficacy	Lack of confidence/self-doubt in capabilities	Laura, Lucy, Claire (Active)
Mathematics professional development	Role of coach? Math unit planning Lack of alignment—applicability with grade level—PD and classroom connection Too much focus on curriculum planning—not enough on practice No time to apply what is learned to practice Miscommunication between different levels—math curriculum? Mode of participation	All teachers (active/passive)
Institutional factors	Leadership roles? Who is driving the 'train' What is the direction the school is heading? What about PBL?	Mia, Olivia, Emma (passive)

Nearly all of the teachers expressed at one point that they experienced tensions related to the ability to maintain a work/life balance, making self-care a priority, classroom management, concerns with reaching all students, and the lack of time to complete tasks. Three teachers (Laura, Emma, Mia) experienced more tensions related to interpersonal relationship issues. Four teachers (Laura, Lucy, Claire, Olivia) reflected on tensions related to their own self-doubts on their abilities to be a teacher—their teacher self-efficacy. Three teachers (Mia, Emma, Olivia) reflected on tensions related to institutional factors—such as lack of clarity regarding school goals. All teachers expressed tensions or issues experienced within the context of mathematics professional development—this included both Wednesday afternoon PD sessions and weekly PLC meetings. Tensions predominately stemmed from the miscommunication of information from all different levels (Administration, PD designer/facilitator, coaches, teachers) regarding

the goals and expectations of certain tasks given to teachers in the context of professional development. Moreover, the structure and misalignment of content reviewed between monthly math PD sessions and PLC meetings became a source of tension for teachers as well.

In the next section, I describe and highlight the different types of tensions experienced by teachers during the course of a year as they participated in professional development in the context of mathematics.

Interpersonal Relationship Tension. The kindergarten teachers in this study expressed tensions and conflict working with co-teachers and/or students. The interpersonal relationship issues became a primary source of tension and impacted classroom climate and extended to issues working well collaboratively with grade level team during professional development sessions. A main factor that contributed towards this growing tension was the perceived roles that were implicitly understood by the teachers in the community. For example, many of the conflicts and tensions that arose between Laura and Emma were due in part because of particular role expectations that were implicitly given to Laura as a new teacher. Laura was perceived as the "new teacher" and what came with that role were expectations of how a new teacher should "act": "She comes in, like, "I'm going to teach us how to do it." I'm like, "Where did you come from?" You're supposed to be a brand new teacher" (Emma, Post-observation Follow-up Interview, 4/14/16).

Laura, on the other hand, was aware of her role as a new teacher, and struggled to find balance between her role as a new teacher and as being included as a member of the grade level team. She struggled between wanting to learn and not overstepping her role as a new teacher. Moreover, the conflicting personalities and differences in teacher practices and disciplinary actions between herself and her co-teacher created tensions within the classroom environment

and impacted Laura's experience in professional development. This sustaining tension would impede the development of collegial partnerships and productive learning interactions within the group, in particular, for Laura who expressed this concern:

> I just feel like in terms of creating a community and a culture of growth, I do not feel like that exists in this space for me right now—feel like there are resentments for things that have changed—feel like people aren't interested in having conversations about math (Laura, Post-observation Follow-up Interview, 4/11/16).

For Laura and Emma, in particular, their interpersonal relationship tensions affected them both in the classroom and professional development context. For example, Laura and Emma also experienced conflict with maintaining consistency with classroom routines and responding to student disciplinary issues as a united front.

Student learning. Concerns regarding how students were progressing and learning were more often expressed by the teachers in grade five as well as Laura in kindergarten. In 5th grade the concerns were connected to the Smarter Balanced Assessment Consortium assessment (SBAC). A source of tension for the teachers was whether or not they were preparing students well enough to take the assessment, not just regarding the academics but about students' emotional well-being:

> We're heading close to SBAC and so I'm very worried because I'm very worried about my kids and it's not about wanting them to do well, I don't care about if I get a class with great scores and looks good on me, I care that...I'm going to put these kids in front of a test and I want them to be able to see this test and be like 'oh, I can do this' as opposed to 'whoa, what is this?' can you imagine their confidence and their internal battle? and it just kills me that as a teacher I'm sending this child out to do like, you know, the mud run

> without training and so I just think about their...like I don't want them to be discouraged and so it's hard because we worked so hard this year and yet I don't feel confident for them (Lucy, Post-observation Follow-up Interview, 3/31/16).

It was not surprising to see that SBAC was a concern for the 5th grade teachers, given that students were to be tested in 5th grade and not in kindergarten.

Teachers were also concerned with supporting all students in learning, those who needed additional support and those who needed to be challenged. Tensions were in figuring out ways to differentiate efficiently and effectively so that there was an assurance that teachers will have prepared students to achieve mastery in 5th grade content by the end of the year, especially for students who came into 5th grade and lacked the basic foundational skills:

> How am I meeting the needs of each and every one of my students in my class for math…students who are coming in without the skills they need, how do I address those skills but still get them to the end of the year (Heather, Post-observation Follow-up Interview, 4/1/16).

Despite not having the pressure to prepare her students for SBAC testing, Laura dealt with her own tensions regarding student learning. She viewed her role as a kindergarten teacher to be a crucial piece in students' academic path and held strong personal goals to effectively build the foundations that were necessary for students to be able to be successful in later grade levels.

Teacher self-efficacy. Novice teachers who joined a new grade level team expressed concerns regarding their self-efficacy as a teacher. It was not surprising to see that both Laura and Claire, who were new teachers and new to their grade level teams, experienced tensions in this area. It was discouraging for teachers to see students not meeting learning goals despite investing countless hours to mathematics planning. Teachers' perceptions on their capabilities of

being an effective teacher were challenged when they were unable to see students achieving positive results on mathematics assessments. As a new teacher to her grade level team, Claire compared herself to her other co-teachers. This comparison led to her feeling self-doubts regarding being able to keep up with her co-teachers, thus she found herself questioning her self-efficacy as a teacher. Tensions arose regarding if she would be able to keep up with her team, and if she was pulling her weight within the group: "…so I feel some conflict there, like am I contributing enough, is this ok, do they like that, I'm unsure with that." Laura expressed similar concerns and began to question her self-efficacy of becoming an effective teacher when she struggled with supporting students in reaching learning goals and reaching proficient standard ranges.

Mathematics professional development. A main source of tension among all teachers regardless of grade level involved issues that were brought on within the context of mathematics professional development—this included both school-wide afternoon sessions and weekly grade level PLC meetings. Tensions arose when teachers' expectations of what was to come out of the mathematics professional development were not being met. Teachers' perceptions regarding the role of a coach were different from what they experienced. Teachers were unclear of the expectations regarding the process and protocols that surrounded the math unit planning that was taking place during their PLC meeting. There was even a lack of clarity regarding which math curriculum was to be used during the unit planning—this issue was never clearly resolved until toward the end of the year. Without a clear understanding of the overall purpose and goals of the mathematics professional development, teachers were not fully committed to the process and in some cases felt their teacher professionalism was being questioned:

> I just would like to know where we're going with it all, I really would--like I know why we're doing it but like I said, who's driving the train, just tell me, just tell me what it's all for, and I haven't asked, so maybe I should just ask, maybe I should just try to figure it out--I think that's the hardest thing, not knowing where we're heading, and like where it's all going, and it's almost like a matter of trust, like do you trust us to be teaching math (Mia, Post-observation Follow-up Interview, 6/2/16)?

For the most part, the lack of clarity regarding the goals and miscommunication regarding what the established process of building a unit plan was resulted in teachers complaining that too much time was invested in unit planning and having qualms regarding the necessity of having to unpack standards at such a deep level. These issues created much tension among the teachers and many became concerned and conflicted regarding the goals of the school. Due to not having clarity and understanding regarding why there was such a strong focus on mathematics for professional development for the academic year, the time spent focused on this subject matter grew to be a source of tension for teachers. Many expressed frustration regarding why there was such a focus only on math and perceived they were neglecting other subject areas.

Olivia and Emma expressed their tensions and frustrations in response to not having actual lessons planned after spending so much time unpacking standards and curriculum planning. The general feeling was that actual tangible lessons should be planned during those times as well. This perplexed and frustrated Emma and Olivia and it further pushed them to view the PLC meetings to be ineffective and to be an inefficient way to be using their professional learning community time, Olivia expressing: “It is like we are doing more curriculum mapping then we are doing lesson planning. Because the lessons are not planned well, we are up there like, uhh…” and Emma expressing:

> Do we really have to dig into the standard? It's there for a reason. It's very research, why do we have to spend an hour digging deep into a standard when we could go be digging deep planning out stuff or looking at student data…if I am going to sit down and plan, I thought I would walk away with a three week plan, all detailed; what I would be teaching for three weeks. I felt like I never left that track (Post-observation Follow-up Interview, 5/26/16).

The afternoon professional development sessions were areas of tension and frustration for some teachers as well. Main issues were due in part to not knowing what the agenda would be prior to the session, the intense focus on mathematics, lack of follow-up after tasks were assigned, and the lack of intentional connections being made with the PLC meetings. Teachers expressed how they wished there was time dedicated to putting what is learned into practice. Whereas so much emphasis and focus was on unit planning, teachers found it difficult to see how all that time spent was having an impact on their teaching practices. Teachers expressed that more time spent on pedagogical practices and math labs (similar to lesson studies) would have been more beneficial and impactful towards their professional development in the context of mathematics instead of such a heavy emphasis on curriculum mapping and unit planning. Furthermore, kindergarten teachers voiced concerns regarding the grade level content that was used during the professional development sessions. Teachers expressed that topics were mostly catered towards upper grade levels. They perceived mathematics in kindergarten to be very specific and expressed frustrations that the focus was never in the content of kindergarten:

> I wish we had one focused kindergarten math PD. Kindergarten math is so different. I felt like I have learned a lot about how to teach division and fractions but not necessarily. Sometimes we sit there and are like, why are we even here. Yeah we know that is

> important to know where this is going but if we don't know how to get them to that point, then what is the point of knowing where it is going (Olivia, Post-observation Follow-up Interview, 2/3/16)?

In particular, for kindergarten teachers, because they experienced tensions related to the applicability of the mathematics professional development to their respective grade levels, this tension further influenced the experience of tensions related to institutional factors.

Institutional factors. The tensions surrounding institutional factors were very much connected to and stemmed from the tensions that arose in the context of mathematics professional development. Teachers predominately in kindergarten began to question the direction the school was heading because they became increasingly frustrated with the expectations placed on them. Teachers felt that they had chosen to come to work at this school because they believed in its school vision and philosophy (i.e., project based learning) However, they began to feel that the vision and philosophy of the school were being overshadowed with the strong emphasis on mathematics. Furthermore, they were not ready to "jump on the train" if they did not know who was driving it. Mia expressed, "But we don't know where it's going or why--it's just a little bit hazy which makes me feel a little uncomfortable" (Post-observation Follow-up Interview, 6/2/16). Olivia also shared similar sentiments: "Until it is all there, it is in order, it is laid out and it is in a book that I can hold and reference. Then I will be on the train (Post-observation Follow-up Interview, 5/26/16). The "train" was a metaphor taken up by the teachers to reference the goals of the mathematics professional development and the direction the school was heading. Mia, Emma, and Olivia did not perceive they were "onboard" this train, and voiced their concerns that it was not clear where the "train" was heading and therefore, they were not completely "onboard."

Tensions in Relation to Mathematics Teacher Identity

Data analysis revealed that the majority of teachers who were on the spectrum closer to an *active* ambitious mathematics teacher identity expressed tensions in the categories of student learning, teacher self-efficacy, and mathematics professional development. The teachers who were on the spectrum closer to having a *passive* ambitious mathematics teacher identity experienced tensions in the areas of interpersonal relationships, mathematics professional development, and institutional factors.

What is noteworthy to see is that teachers who aligned with more of a *passive* mathematics teacher identity experienced tensions related to institutional factors in addition to experiencing tensions related to mathematics professional development. This finding suggests that teachers viewed a connection between institutional factors and mathematics professional development. When they were unable to understand the goals and purposes of the mathematics professional development and did not view the time spent for professional development to be beneficial to them, they began to question the goals of the overall institution. Teachers identified with having an identity more aligned with an *active* ambitious mathematics teacher identity also experienced tensions with mathematics professional development; however, they were committed and invested in trying to see it through and make it work because they believed in the institutional goals—teachers were "onboard the train" because they believed in the direction it was heading. They appeared to have a better understanding regarding the goals and purposes of the professional development and despite experiencing some tensions and frustrations with the mathematics professional development; they stayed committed to the overarching institutional goals.

Up to now, the findings discussed were situated within the space between *aspects of self-in-mind* with *aspects of self-in community* within Van Zoest and Bohl's (2005) mathematics teacher identity framework. Van Zoest and Bohl (2005) proposed that both components influence peoples' interactions and experiences within social contexts and those interactions and experiences (tensions) become opportunities for identity development and change during the learning process. Wenger (1998) also proposed that "A person's identity arises from his/her personal knowledge of and the refinement and adjustment of this knowledge through his/her negotiated experiences within a particular community" (Sutherland, Howard, & Markauskaite, 2010, p. 456). Thus, in the next section I discuss the relationship between *aspects of self-in-mind* with *aspects of self-in community*. I specify how teachers attempt to refine and adjust their knowledge through their negotiation of tensions experienced within the professional development learning community.

PART III Negotiations

Data analysis revealed a relationship between mathematics teacher identities and how teachers negotiated through their tensions. A component that contributed to the construct of mathematics teacher identity was how teachers were positioned by others and by themselves, within their grade level community—their perceptions of themselves and others' in the community. This *self-in-community* component had an impact on the avenues teachers took to help negotiate the tensions they experienced in the context of professional development.

How teachers perceived their role and the role of others within their professional learning communities strongly influenced how they chose to navigate and negotiate through the tensions that arose in the context of mathematics professional development. The teachers in this study all held both explicit and implicit roles that influenced how they interacted with teachers within

their grade level teams and the rapport that was established with administration (see table 4.3).

Table 4.3

Teacher role and positioning in community

Teacher	Roles within school and learning community	(Active/Passive) ambitious mathematics teacher identity
Heather	"veteran"—founding teacher, leader in school, grade level rep	Active
Lucy	"veteran"—founding teacher	Active
Claire	Novice teacher—"floater" role—new to grade	Active
Laura	Novice Teacher—new to school	Active
Mia	"veteran"—founding teacher—co-grade level rep	Passive
Emma	Co-grade level rep—also considered "veteran" within grade level	Passive
Olivia	Novice teacher—first year as co-teacher	Passive

Teachers who were positioned and held the roles as "veteran" teachers—founding teachers at the school—were more vocal with administration regarding frustrations, conflicts and issues that arose for them or their team. Their role in the school community afforded them a different level of rapport with the principal at the school and thus many times their negotiation of tensions was to speak up and voice their concerns with the principal directly. Teachers who were positioned in the school community as the "veteran" teachers and/or leaders within their respective grade levels were Heather and Lucy in 5th grade and Mia and Emma in kindergarten. These teachers generally negotiated their tensions by first discussing them openly with their co-grade level "veteran" teacher (Heather with Lucy, and Mia with Emma) and if they were unable to come to a solution, they approached the school principal directly to voice their concerns. Their "veteran" status and leadership roles within their respective grade levels afforded them a different level of rapport with the school principal and administration when compared to other teachers. In contrast, teachers who were not positioned as "veteran" teachers by the community would be less

forward with expressing their frustrations and tensions with administration directly. They tended to seek outside support networks.

Active Mathematics Teacher Identity and Negotiation of Tensions

Heather, Lucy, Claire, Laura. Heather and Lucy were considered "veteran" teachers. Both were founding teachers when the school opened and were viewed as leaders by the school community. Their role status implicitly positioned them to be among the few who were made first aware of different administrative decisions. They both had a level of rapport with the administration which allowed them to feel comfortable asking questions and sharing particular tensions that arose in the context of professional development. Moreover, having worked together for the past three years, they also developed a level of familiarity with how each other worked. This positive working partnership allowed them to feel at ease to communicate with each other when tensions or conflicts came to surface. Both shared that they were each others' *go-to* person when tensions arose and both were very comfortable in communicating with administrative as well. However, Heather's involvement in multiple communities within the school elevated her leadership role to a different level than Lucy and influenced how she navigated and negotiated through her tensions. Because she held different leadership roles in other communities (i.e., administration), she was aware of school initiatives prior to Lucy and the rest of the school staff.

Heather's *active* ambitious mathematics teacher identity developed as a result of the overlapping components between self and community. Her developing *active* mathematics teacher identity was influenced by social and contextual elements. Having a close relationship with the administration, Heather was more knowledgeable and aware of the goals and direction of the professional development. This allowed her to better recognize that change was not easy

and that learning and progress took time and effort. Therefore, she was willing to invest her time and be committed to the professional development, despite experiencing tensions.

When Heather experienced tensions in the context of professional development, she negotiated the tensions by first communicating with her grade level co-teachers, Lucy in particular, and she was also comfortable with communicating directly with administration and/or individuals involved with the professional development. For example, Heather expressed the affordances of being a part of multiple communities and how she negotiated tensions:

> I mean I feel like a lot of the tensions, that I personally might have, are really I talk to with my team, and mainly, like I know I could talk to Lucy about any tension, but I also feel like I could talk to Lucy and Claire about a lot of them, so I mean--we do have a lot of conversations. I also have ones with Abigail (PD designer/facilitator), you know conversations--kind of we pick each others' brains, because there is that like I said different information and I feel like I'm fortunate to be in a lot of the different things (different communities among the school)-- yeah, so I feel like...I have more of a perspective than some other people.... and so because of that I'm able to like talk to Abigail about it…(Heather, Post-observation Follow-up Interview, 5/31/16).

Despite Laura and Claire holding similar roles in their respective grade level community, their negotiation of tensions differed, in Laura's case, due in part because of the conflicting mathematics teacher identities between herself and other teachers in the kindergarten community. Laura and Claire were both considered "new" to teaching for their grade level and viewed as novice teachers among the teachers in their grade level teams—thus there was a perception made by their peers that because they were "new" teachers they were not expected to know *everything* and were positioned as learners. An interesting finding that emerged in the data

revealed the influencing power that grade level group dynamics, associated with mathematics teacher identities, had in promoting a collaborative professional learning community that was conducive towards building positive collegial interactions and promoting productive tensions. Laura's developing *active* ambitious mathematics teacher identity came in conflict with her grade level teachers' developing *passive* ambitious mathematics teacher identities, thus her approach to negotiating tensions was to seek outside support because she felt that she was an "outsider" within her grade level group. Whereas, Claire's developing *active* ambitious mathematics teacher identity aligned with her grade level team's developing *active* ambitious mathematics teacher identity. Therefore, despite feeling like a "new" teacher within the group, she did not feel like an outsider and was comfortable in learning from her co-teachers and communicating with them regarding tensions or issues that arose.

Despite having similar roles within their respective grade level communities, their role and how they were positioned by others in their grade level community, influenced by their mathematics teacher identity, had an impact on Laura and Claire's approaches toward negotiating their tensions. The alignment and misalignment between Laura and Claire's developing mathematics teacher identities and their respective grade level community's developing mathematics teacher identities created different group culture and dynamics that impacted the approaches taken by Laura and Claire to negotiate the tensions they experienced. This finding demonstrates the importance of attending to individual and context as proposed by van Zoest and Bohl's (2005) within their notion of *aspects of self-in mind* and *aspects of self-in-community.*

Laura's approach to negotiate the tensions she experienced in the context of mathematics professional development was very different in comparison to Claire's approach. As a new

member to the kindergarten group, Laura was positioned to be a new teacher and learner. The "veteran" teachers in the group did not anticipate being challenged or led by a new teacher. Moreover, Laura's developing *active* ambitious mathematics teacher identity came in conflict with her co-teachers' *passive* ambitious mathematics teacher identities and therefore, her views and experiences regarding the mathematics professional development were in stark contrast with her grade level community. The difference in perspectives created tensions related to interpersonal issues with her grade level team, thus resulting in Laura feeling even more as an "outsider" and feeling that her professional learning needs were not being met. She also felt that her co-teachers were not as receptive towards the professional development sessions in which they were participating in:

> I get so frustrated because there are members of the team are like "These are a waste of time, this is what—I don't why do we have to do learning goals for everything, why do--?"…You know, it's like I get so frustrated when they are there complaining about it…It's like, you know what? Do you know what kind of privilege it is to get this kind of training? To have time to sit together and think... and you want to rush out of here (Laura, Post-observation Follow-up Interview, 2/12/16)?

Laura would therefore negotiate through her tensions by seeking outside support, mostly seeking the advice and support from the professional development facilitator, Abigail. The professional/mentor relationship that she developed with Abigail started back when Laura was a credential student and Abigail was her instructor. This professional relationship continued to grow and develop. Laura gave credit to Abigail as being the one who challenged her and encouraged her to seek out communities outside of the school to fulfill her professional learning needs:

> Well one of the biggest things that has helped me is Abigail, that professional relationship. That mentor relationship is just so, so important and it was really important for my professional learning like learning about other opportunities and creating community beyond this space. That was really--because certain ways I did not feel that my needs were getting met (Laura, Post-observation Follow-up Interview, 5/24/16).

> I was having a conversation with her and she was really like, the education world is so much bigger than [school name] Like of course ideally you have those kinds of conversations that advance you as a learner and the teachers within your school community because you are here, you see them every day. But if you are not getting that, it does not mean it does not exist. It means that maybe you have to look outside of this space (Laura, Post-observation Follow-up Interview, 5/24/16).

Laura also adapted her approach in how she participated in the grade level PLC meetings. She previously experienced resentment and backlash from the grade level community when she would be too vocal about her thoughts and ideas, or when she attempted to share new ideas acquired from conferences she attended. She also learned that her grade level community appreciated when she would come to them first with questions; they perceived it as an indication that she valued their input. Seeking a different approach to how she asked questions and introduced new ideas to the community, essentially adapting her mode of participation within the group, was how Laura negotiated the interpersonal tensions that she experienced in her grade level team. Laura's developing *active* ambitious mathematics teacher identity came in conflict with her grade level team members' developing *passive* ambitious mathematics teacher identities and resulted in Laura experiencing tensions and feeling like an outsider. Laura's way to negotiate through these tensions was to find learning communities and spaces that supported her

professional development learning needs. As she ventured towards finding communities outside her school, she came to realize that she was not an "outsider" and she found these learning spaces to be productive towards meeting her professional development needs.

In contrast, Claire's negotiation of tensions that she experienced in the context of mathematics professional development differed from Laura, despite both cultivating an *active* ambitious mathematics teacher identity and being positioned within their grade level teams as "new" teachers. Based on Laura's and Claire's experiences and accounts of teacher interactions during professional development sessions and grade level PLC meetings, it was evident that Claire experienced a different culture of group dynamics and interactions with her co-teachers as compared to Laura. The group dynamics and culture of a grade level community was influenced by the different perspectives that came with where teachers were placed on the mathematics teacher identity spectrum. Claire's developing *active* ambitious mathematics teacher identity aligned with her co-teachers, whereas, Laura's mathematics identity differed from the co-teachers in her grade level community.

Claire's negotiations of the tensions she experienced in the context of mathematics professional development were to communicate with her co-teachers and to ask questions during professional development sessions. She appreciated the professional development that was provided for her and she was committed and invested in learning opportunities to develop and expand her 5^{th} grade content knowledge and pedagogical practices. Claire was very much aware of her role as a "new" teacher within her grade level team and was content to view her role as a learner. She also felt fortunate to be learning and being a part of grade level team that was highly respected by other teachers, " I feel good with my team, like and I heard from other teachers from other grade levels, they told me you are part of "the" team"(Post-observation Follow-up

Interview, 5/19/16). During times when she thought she was not meeting expectations and working at the same pace as her co-teachers, she negotiated through these tensions by reminding herself that she was a new developing teacher and she was not being fair to herself by constantly comparing herself with her "veteran" co-teachers. Claire had different support structures in place during her first year as a 5th grade teacher. At times she relied on personal relationships with friends and family outside of her school community to help her negotiate the tensions that came with being a new teacher, such as feelings related to self-efficacy and work/life balance. However, regarding tensions related to mathematics professional development she negotiated through them by communicating with her team:

> …finding that place within the team where I feel like we're all equitable and equally valued and, I don't know, I've just felt little comments here and there that made me feel like yeah I really am appreciated and they know that, and we feel good, like it feels, like I really like my team. I love my team, I really love them…I want to emulate them in some ways, like I really have been positively influenced by them (Claire, Post-observation Follow-up Interview, 5/19/16).

Claire felt supported within her grade level team and was eager to learn from them. She worked hard to become a contributing member of her grade level community because she admired the work ethic and can-do attitude that was expressed by her co-teachers.

Passive Ambitious Mathematics Teacher Identity and Negotiation of Tensions

Mia, Emma, Olivia. Mia and Emma negotiated the tensions they experienced in the context of mathematics professional development in similar ways. As "veteran" teachers in their grade level, they already had developed a friendship that extended beyond the classroom. They viewed each other as not only as co-workers but as friends. This relationship became a source of

support and space for discussing tensions that arose for both of them. They generally negotiated their tensions by discussing them with each other, as well as with their grade level community. Moreover, they had a level of rapport with the administration and thus were comfortable in addressing any tensions or conflicts directly with the principal and/or coach if needed. However, a sudden shift in leadership role, prior to the beginning of the academic year, impacted Mia's relationship with administration and the tension that arose from the situation influenced how invested and committed she was towards the mathematics professional development and the direction of the school:

> I'd like to give myself credit for that [referring to role as leader in group],only because that was my role for 3 years and this year it was a little bit thrown off , which was awkward for me…getting an email that I'm not even on any of these committees, no one came to talk to me, no one called and asked how I was--if I wanted to do it--that was a tension in the year--I put a lot of time for school in the summertime--they assumed that she wasn't going to be able to do it… I was bitter in the beginning…so it took me a while to come back from that… I got very defensive is what I think happened--I thought if they aren't even going to ask me, then I'm not going to give you any of my time and my investment in it (Mia, Post-observation Follow-up Interview, 4/15/16).

Due to having to take a step back in her leadership role within the grade level, Mia felt excluded from the conversations regarding school wide directions that she used to be a part of during grade level representative meetings. Mia began to develop some tension related to not only professional development but also institutional factors. A great tension that she experienced was dealing with the issue that the focus on mathematics was overshadowing project based learning—which was a founding tenet of the school. Many times she would voice her

frustrations regarding the intense focus on mathematics. This tension was also experienced by Emma and Olivia, however, Mia was the one who voiced this frustration more openly during PLC meetings. Mia negotiated this tension by speaking directly with the kindergarten coach and with the principal. This action taken resulted in structuring time during the school day to accommodate the need to plan for *projects*—something that was important to Mia, "I don't drive an hour to teach what everyone else is teaching at every other school."

Mia and Emma's developing *passive* ambitious mathematics teacher identity impacted their experiences with the mathematics professional development. Their lack of recognition regarding the potential learning outcomes that could result from the professional development resulted in them displaying some feelings of push-back regarding the goals and expectations of the professional development. The heavy emphasis on unit math planning was not considered necessary or time well-spent to Mia and Emma. As a result of their inability to understand the overall purposes and the usefulness of the tasks that are given to them in the context of mathematics professional development, their ways of negotiating the tensions they experienced was to do what was expected of them, despite not being "onboard" with the overall goals. Therefore, their commitment and investment in the mathematics professional development were marginal and this contributed towards their passivity towards learning and their level of engagement during the meetings.

Olivia was the furthest along the spectrum toward a *passive* ambitious mathematics teacher identity. Similar to her grade level co-teachers she experienced tensions related to the goals of the mathematics professional development and stressed the overemphasis on mathematics during their PLC meetings, however, Olivia was less comfortable with sharing her struggles and tensions with the group. Her negotiation tactics were either to "go with the flow"

despite not being "onboard," or delegating the responsibilities to her co-teacher. Her negotiations of tensions reflect the role that she internalized for herself.

Olivia was considered a novice teacher by her co-teachers because despite having been at the school for the past three years, she never held the role as an equal co-teacher. She was aware of this new role and attributed her past roles as influencing her approach towards negotiating tensions:

> My role was lower so I did not speak up about stuff that I was unsure about or stuff that bothered me, I just said, you guys are the teachers, responsibility is not on me. I am just going to shut my mouth and let you do it that way. Then as my position went up and now being co-teachers with Rebecca, I am like, now if something is bothering me or if I don't agree with something, I need to say it so yeah. That rarely happens…(Olivia, Post-observation Follow-up Interview, 5/26/16).

Olivia was reluctant to speak up and to share the struggles she has with certain pedagogical practices. Instead, Olivia takes the approach of relying on her co-teacher to support her. For the first few months of school, to negotiate the tensions that she felt regarding her lack of confidence in teaching mathematics using Cognitively Guided Instruction, Olivia deferred teaching mathematics to her co-teacher entirely. Olivia was still in the process of establishing her footing in her new role. Her identity very much reflected a level of passivity, where she did not want to disturb the peace even if she had questions with certain issues or expectations:

> Yeah. I feel like you just have to and go with the flow…even if it's something that I do not technically agree with, if we agree as a team and I am the minority, the only one that doesn't want to do it, I will do it because the majority vote said we are doing it this way. I'd rather stay united than to prove my way or make my way still happen. I do not really

> care as long as there is a good reason for it (Olivia, Post-observation Follow-up Interview, 5/26/16).

Mia and Emma negotiated their tensions in similar ways. They relied on each other to discuss the tensions that arose due to interpersonal relationships, mathematics professional development, and institutional factors. They also were comfortable in taking the approach to voice their concerns with administration. This level of rapport was established due to their "veteran" status as kindergarten teachers. Olivia, on the other hand, negotiated through her tensions more privately and was less open with her grade level team and administration.

They ways in which teachers were positioned by others and subsequently the roles they came to take on within their communities impacted the types of approaches they took to resolve and negotiate the tensions they experienced. These findings highlight the value of understanding the influencing role that community has in relation to teacher learning and mathematics teacher identity development.

CHAPTER 5

Research Question Two Findings

This chapter shifts the focus from the individual to the community. Van Zoest and Bohl (2005) highlight within their mathematics teacher identity framework the important role of community and ultimately the interaction between self and community (participation), and its impact on identity development, "…our identities are the vehicles from within which we participate with others in community—vehicles that provide both potentials for and limitations to our participation…" (p. 320). The analysis of teacher interactions with others and their participation within learning communities provide opportunities in which to better understand mathematics teacher identity development.

The purpose of this analysis was to understand the relationship between mathematics teacher identities and teachers' participation within professional development, in particular, how teachers' mathematics teacher identities influenced the ways in which they participated in a new community and "becoming" a member of the community. I framed my analysis based on Wenger's (1998) notion that identity is shaped through participation and learning within communities. Therefore, a teacher's engagement and participation in the practices of a community, referred to as developing the *dimensions of competence* to participate in the practices of a community (refer to Figure 2.1), have an important role in shaping their identity and their learning experiences in a new community. This notion is further expanded by Van Zoest and Bohl (2005) who conceptualize within their mathematics teacher identity framework the need to focus on understanding how teachers interact and participate in community and its impact on identity construction. For this analysis, I turn my focus to the second component within their mathematics teacher identity framework—Community.

Analyses for research question two involved different phases of analysis between two data sources: Professional Learning Community (PLC) meeting observation notes/and video and Follow-up teacher interviews. The goal of analyzing the PLC meeting observation notes/and video was to collect an overall understanding of how the community (PLC) functioned as a whole—the particular social practices and modes of participation that each grade level group utilized (kindergarten & 5th). I drew from the literature on effective features of professional development to help guide the analysis of the social practices and modes of participation reflected within a grade level community (Desimone, 2009; Lord, 1994; Loucks-Horsley & Matsumoto, 1999). Opportunities for active learning and collegial partnership were spaces in which learning could take place and where teachers were potentially reconciling and negotiating new ideas with their existing schemas. Using these moments of group discussions and interactions, I analyzed the ways in which teachers interacted and shared their ideas to better understand the dimensions of competence that were embedded in the social practices within a grade level community. I also drew upon the interview responses collected from teachers as a way to affirm the observations that I made. For the second phase of analysis, I selected two teachers in grades kinder and 5th to highlight their particular experiences as novice teachers transitioning into a new grade level community. I focused, in particular, on each of their unique experiences with becoming members of a new community and thus developing the dimensions of competences respective to their professional learning community. In addition to analyzing their participation and interactions with others in PLC meetings, I also analyzed their Post-observation Follow-up Interviews to gain a firsthand account of their perceptions regarding their own experiences working with others in their grade level communities. This analysis also helped

to substantiate the observational findings regarding their participation and interactions with others during the PLC meetings.

Findings revealed that the modes of participation linked to a grade level community--mutuality of engagement, accountability to an enterprise, and negotiability of repertoire (see Table 5.1)—were related to the mathematics teacher identities that teachers came to take on within the grade level community and were related to the roles teachers were positioned to have in the community as well.

Table 5.1

Dimensions of Competence for grade level community

	Kindergarten	**5th grade**
Mutuality of Engagement	Established agenda and roles Cautious about offending others	Established agenda and roles Challenge each other ideas and make thinking visible Purposeful with maintaining an inclusive community
Accountability to an Enterprise	Not committed to the goals of mathematics professional development—stronger commitment for other topics (project based learning) Not fully "onboard" with the direction of the enterprise	Committed to the goals of the mathematics professional development Fully "onboard" with the direction of the enterprise
Negotiability of Repertoire	Refer to personal philosophies of teaching Reference to past practices Refer to past student outcomes	Making sense of standards and learning trajectories Reference to past practices Refer to past student outcomes

Teachers' participation in the assigned tasks during PLC meetings (i.e., unit planning, unpacking standards, etc.) connected to their Accountability to an Enterprise. It was difficult for

teachers to be fully invested in the mathematics professional development when they were not "onboard" with the direction the school was heading and when they did not have a clear and consistent understanding of the goals of the PD. Moreover, many issues and tensions arose in part because of the time investment that was being explicitly dedicated to mathematics. Below, I elaborate on the findings that speak to the relationship between mathematics teacher identity and teachers' participation in professional development—individual in relation to community. In particular, I highlight the experiences of two novice teachers who were in the process of becoming members of a new grade level community, with a particular focus on how their mathematics teacher identities and the identities of those in their community informed their learning experiences within their respective grade level communities. Their experiences with developing dimensions of competence to participate within their respective grade level communities help shed light on the influence of mathematics teacher identities in teachers' participation within professional development and their experiences with becoming members of a community and working towards the goals of a community.

The three components that comprise the dimensions of competence for the kindergarten and 5th grade professional learning communities include mutuality of engagement, accountability to an enterprise, and negotiability of repertoire. I then focus on two cases, the cases of Laura and Claire as they develop dimensions of competence in their respective grade level community to highlight their participation and learning experience in the grade level communities.

Kindergarten Professional Learning Community

The kindergarten professional learning community was comprised of six teachers. Each of the three kindergarten classrooms was led by two teachers working as co-teachers. The number of teaching experience did not surpass six years for the teachers in kindergarten. Despite,

the lack of experience teaching, teachers who had been at the school since its opening were positioned as "veteran" teacher status by the school community. Their role as "veteran" teachers afforded them a position that allowed them to take the lead on particular situations and decision making within the grade level. For example these "veteran" teachers held the role of grade level representatives, and they facilitated the meetings when the coach was not present. Their strong presence and role within the community influenced the modes of participation that came to be within their professional learning community. For example, Mia initiated the "clearing protocol" in the agenda for the PLC meetings. The "clearing protocol" was time set aside to allow teachers to share whatever was on their minds prior to the start of each meet. This then became a set protocol for the start of each PLC meeting.

There was a sense of group camaraderie among the teachers who worked together for the past couple of years. This was most evident based on the off topic conversations that occurred during PLC meetings—planning weekend BBQs and dinners, reflecting on past events that they shared and experienced. It was clear that for the teachers, who had worked together previously, their friendships extended beyond the classroom. The friendly rapport and established relationships could be observed in the ways they engaged in conversations with each other. This friendship and familiarity with each other proved to be a difficult hurdle for Laura, the newest member of the group, as she tried to become a member of the community. This was most evident when Laura expressed her perception of being an "outsider" in the community. In the following section I describe the dimensions of competence that reflect the kindergarten community.

Mutuality of engagement. The structure and organization of what occurred during a PLC meeting was made visible on the agenda created before each meeting by the coach. The agenda reflected a general structure regarding topics to be discussed, time allotted for each topic,

and the order in which each topic and task will be discussed during the meeting. In essence, the agenda itself created a sense of understanding regarding the expectations of what was to occur during each meeting. Roles such as facilitator, timekeeper, and note-taker, were assigned at the beginning of each meeting. These pre-established roles helped to inform the teachers regarding the expectations in how meetings would be run and how teachers were expected to participate. For example, the facilitator led the meeting by going through the topics on the agenda and the timekeeper made sure that all were on topic and on task based on the designated time in the agenda. The note keeper took notes on what was discussed. These notes were all shared with the group.

As protocols and processes for unit planning (main focus of PLC meetings) changed during the academic year, "veteran" teachers experienced tensions with how to mutually engage with each other productively while completing tasks and abiding by the expectations regarding how to unit plan. These tensions manifested themselves during discussions while the group went through the process of unit planning. One particular segment that highlights the lack of mutual engagement with the process of unit planning was brought up for discussion by the two "veteran" teachers. While in the midst of going through the process of unit planning the teachers shared their concerns regarding the new steps and processes of unit planning and their lack of contentment regarding not being able to refer to things they had done in the past. This sentiment was brought up by Emma and Mia, both "veteran" teachers, during a PLC meeting in February while the group was in the midst of unit planning:

Emma: I just keep thinking about…like can Ms. Olivia bring her big math binder, she has all these activities and stuff from last year, and I feel like we aren't

utilizing what we've done before…it's not like our standards have changed that greatly since last year…

Mia: Didn't change at all

Coach: So what we want to do is...I think that standards haven't changed but the intentionality and teaching of them have…

Emma: I agree to that, but I also want to be using some of our resources and that's a resource we've made already…

Teachers wanted to use what was familiar to them and had conflicts over having to create new resources or perceived it was not the best use of their time. These concerns regarding the cost and benefits of engaging in this new process of unit planning were expressed by teachers during interviews as well. Olivia shared her thoughts regarding not being able to actually have tangible plans made during the PLC meetings even though they have spent so much time unit planning. She expressed that she thought the process of unit planning they engaged in weekly was not supporting her mathematics teaching in the classroom:

> Because also a lot of like, okay this unit is this, so we need to do this type of lesson. That type of lesson and that type of lesson and that type of lesson but then we do not really talk about what the lessons look like. So when it comes time to like, okay we are in the classroom, it is time to teach the lesson. Then we turn to each other and we are like, wait what was the lesson today? What were we supposed to do? Oh my gosh. I think we were supposed to do this and then we say it and we planned more but we did not plan the lessons. It is like we are doing more curriculum mapping than we are doing lesson planning. Because the lessons are not planned well, we are up there like, uhh…Yeah. How am I supposed to bring this objective into practice? Then we do a lot of like, bring

> their thing back. Did they not get it? That is great but at the same time, I don't know. I just feel like we spend so much time on it and I do not see a lot coming from it. Not a lot of student results are coming (Olivia, Post-observation Follow-up Interview, 4/13/16).

Led by their coach, the kindergarten community followed the protocols and processes involved with unit planning and attempted to abide by the expectations. However, concerns regarding the potential student and teacher learning outcomes from engaging in such a process were evident in their conversations and interviews. Their continued dissatisfaction regarding the focus and structure of their PLC meetings became an impediment for the group in being mutually engaged with the goals of the mathematics professional development.

Accountability to an enterprise. Teacher commitment and accountability to the goals of the mathematics professional development became a critical component to understanding teacher participation and engagement in professional development. The different conflicts, tensions, or incongruence of ideas that arose during professional learning community meetings were primarily due to teacher differences related to their commitment and perceived accountability to the enterprise, in this case, the "enterprise" being the goals of the mathematics professional development. Findings revealed that teachers started to exhibit attitudes that reflected a lack of commitment or "buy in" regarding the goals of the mathematics professional development, particularly regarding the time dedicated to math unit planning. Mia expressed during a PLC meeting the difficulty in making sense of how to keep up with all the expectations:

> I know...ideally we should be doing this stuff...ideally we should do this in every single thing, but when? And I'm asking this logistical, because this is obviously how we would like to be teaching, right, you said our intentionality of last year versus this year is different…Yes, our students knew every single standard for the most part by the time

> they left our class last year, and the first grade teachers were like wow in math these kids actually know what they're doing...but my concern is we're doing all this great stuff, were unpacking it, but by the time we go to plan it and implement it, it's like a month later….so we're supposed to unpack it like week-wise like today, plan Thursday, and do it next week?

In addition to concerns with the extensive time that was required of them, Mia's added reference to how well their students did in mathematics the previous year reflected her lack of "buy in" regarding the student learning outcomes from engaging in the new unit planning process. This sentiment was also expressed by Emma during her interview:

> We're doing all this math planning, but yet we feel like our kids are behind more in math this year…like how is that possible because we – I haven't felt like we've had a clear path all year with math, it's been very choppy and very – "Oh. We did a pre-test, but we didn't do a post-test over year," or "We did a post-test, but not a pre-test." I feel like there's just not enough time to get everything together or we're focusing on, "Let's dig into the standards more." Why are we doing that when there's other things that should be done first, or we should save more time for? 'Cause the standards are written in the way they're written and people have already done this research on what works. Why are we diving into it and spending an hour on packing and figuring out what's the progression we want… doesn't someone have that down already (Emma, Post-observation Follow-up Interview, 4/14/16)?

Given that the "veteran" teachers of the group struggled with seeing the benefits of engaging in this new form of unit planning, this attitude trickled down to the rest of the group. It became a constant struggle for the community to be committed to the goals of the professional learning

community in the context of math unit planning, especially when the group came to see that mathematics took precedent and unit planning was all encompassing. For example, teachers viewed "Projects" as an important topic to be discussed and planned collaboratively. The kindergarten community viewed Project Based Learning to be a critical tenet of the school's philosophy of teaching, one in which they held a higher accountability compared to mathematics. This was made apparent by comments made during PLC meetings, such as: "We are running out of time…we won't be able to get to projects again." This sentiment was also expressed during interviews in reference to the professional development focus on mathematics only:

> I feel like we have really been focusing on math but I'm like there are other things that I don't want to push aside. I feel in our team, that is a big like when have time about projects? …and then that's like we are technically a PBL school. So yes, we need more time for that. I feel like definitely our team feels this. Especially people who have been here like day one. I was here the second year it started. We know how we have done before and now how things have changed so it's kind of hard to sit through these meetings. We are like, what about this (Emma, Post-observation Follow-up Interview, 2/9/16)?

As the goals of the professional development evolved during the academic year, changes regarding the trajectory of plans were not clearly communicated to the teachers. This was detected based on teachers' reaction to not knowing that the PLC meetings were to be dedicated to mathematics only:

> Emma: You telling us that PLC is just about math…
>
> Olivia: Yeah, we didn't know that
>
> Emma: Yeah, we hadn't heard that

Olivia: cause it's just nice to know that cause we're always like, there's no time for projects, when are we talking about projects? We didn't even know that's not something to be talked about…

Mia: then logistically, I don't know if this is a question for you or for (principal) then when are we supposed to do that…other stuff?

It was not until the end of the year that the teachers became more familiar with the process, although still not completely "onboard" and convinced with the direction of the "enterprise:"

> I think I'm sitting on the train, still not quite sure, I'm standing on the train, I'm on the train but I haven't sat down yet because I don't really know who's driving the train--I don't know--but in the train but standing--I'm all about it, on board, but need a bit more clarification of where the train is going and what the point of the train (Mia, Post-observation Follow-up Interview, 6/2/16).

> I'm not sure where we're going." Yeah and just knowing that we've done all this stuff this year. Yes, we have all these great plans documented, but does this help us this year? Did it help our instruction? Maybe next year it will. But we're interested in where it's going (Emma, Post-observation Follow-up Interview, 4/14/16).

The lack of accountability to the enterprise could be attributed to the community's struggle with being completely "onboard" with the goals of the mathematics professional development. This was also connected to their accountability and commitment to another "enterprise"—Project based learning—and teachers not fully convinced that the unit planning process they were required to participate in was in fact supporting student learning.

Negotiability of repertoire. The shared repertoire of practices that the kindergarten team embodied as a community could be observed in the ways in which teachers negotiated

conflicting ideas or suggestions. Teachers tended to refer back to practices and ideas that worked in the past, lesson ideas that they were familiar with, or they brought up personal philosophies of teaching when confronted with new expectations and processes with which they did not agree. One particular session highlights this notion of when personal teaching practices conflicted with the protocols in unit planning. The following segment highlights a teacher's concern with her views regarding how some learning experiences were simply to expose and introduce students to new concepts, and not *every* lesson should be designed for assessment purposes. She brought up this issue in the midst of teachers working collaboratively in coming up with learning experiences and assessments during a March PLC meeting:

Mia: If we're building an assessment anyways, the post assessment… I know we have these 'look fors'…but I'm wondering… I don't know the answer to this, maybe you can help me with this...Do we really need to be looking and making sure that every kid knows all these things for on our 'look fors' before the assessment comes?

Coach: oh I don't know about that…

Mia: Because I feel like we're kind of planning our learning experiences as an opportunity to assess instead of planning our learning experiences to teach the kids…a little bit like…like I feel like when we're talking about some of these activities we're thinking like well how are we going to find if they know, but we're supposed to be exposing them, teaching them right? So some lessons might not be some rich task or experiences might not be a chance to have those 'look fors' they just might be exposure and teaching the kids what we're hoping to get out of them later?

As teachers engaged in the unit planning process they found themselves having to negotiate between the new expectations and with what they were familiar and accustomed to previously. At times the negotiability of repertoire was challenging for teachers, especially when they were conflicted with adjusting their long established repertoire of practices that have worked in the past for them. Given that the teachers in the kindergarten group (excluding Laura) worked together in the past and were very familiar with their repertoire of practices. As expressed during PLC meetings and interviews, during moments in which they were confronted with the unfamiliar, they tended to refer back to the ways they used to do things and how their students performed last year.

In the next section, I focus on the case of Laura. Laura was a newcomer to the school as well as to the grade level. Her mathematics teacher identity fell along the spectrum furthest away from the three other kindergarten teachers in this study. Laura's *active* ambitious mathematics teacher identity played a role in her experience and participation in becoming a legitimate member of the community. I now turn to the case of Laura and describe her experiences with developing the dimensions of competence to participate and interact with those in the kindergarten community.

The Case of Laura

Laura's *active* ambitious mathematics teacher identity informed the ways she learned how to approach, participate, and interact with others in her mathematics professional learning community. Her strong views on the importance of learning mathematics influenced her commitment and proactive attitude to seek out professional development in the context of mathematics. She was invested in her own learning and improving her knowledge and practice. This concern with improving her mathematics capacity became a driving force in her wanting to

share with her community new ideas and practices that she discovered. However, because her *active* ambitious mathematics teacher identity differed from the *passive* ambitious mathematics teacher identities that reflected the majority of the members in her grade level community, Laura had to learn how to negotiate through her experiences within the group without compromising her continued cultivation of her *active* ambitious mathematics teacher identity. Her interactions and participation with others in her community influenced her development of competence in the dimensions of mutuality of engagement, accountability to an enterprise, and negotiability of repertoire. Laura's experience with developing competence in each of these dimensions is explained below.

Mutuality of engagement. Laura's unique position as not only a new teacher but a new teacher to the school *and* grade level community resulted in her having the additional challenge of developing competence as a novice teacher and developing the competence in knowing how to mutually engage with her grade level team productively: "I feel like I'm walking this really bizarre line because I'm the newest member to this team and I'm also a new teacher and I'm a new teacher and I'm also older…" (Laura, Post-observation Follow-up Interview, 2/12/16). Laura expressed her feelings of perceiving herself as an outsider of the group. These sentiments were felt based on how receptive her co-teachers were in regards to new ideas that she presented. Furthermore, Laura felt that the community was not an optimal space for her to grow as a teacher, in part, because she felt like a new member having to develop as a teacher outside of the group. This particular segment of an interview conducted in April reflects Laura's continuous struggle with being included as a legitimate member of the community:

> Well I don't know. I just don't, I guess it's like I will bring up these things. Sometimes they are receptive and sometimes--but a lot of times they are not and I don't know. I want

> to--I feel like I want to grow and I am not saying that they don't want to grow. That is not what I--I am not judging anybody. There is no judgment. I am not saying that they do not want to grow. I am just saying that like I have not yet found a way to grow with this team… I just feel like in terms of creating a community and a culture of growth, I do not feel like that exists in this space for me right now.

As such, Laura consistently validated other members' feelings and perspectives while still maintaining her own stance. This was most evident during conversations when her thoughts and ideas conflicted with others. Her comments such as "this is not a criticism," or "this is in no way a criticism to how you have been doing things" during PLC meetings reified the recognition of her position among the group as a new member.

Laura's developing competence in the dimension of mutuality of engagement was best reflected in her approach towards bringing new ideas to the community. Laura struggled with finding her place in the grade level community:

> I feel like I have been kind of fighting to create this space for myself in the PLC meetings where we have these conversations and we build this team. I don't know, I just don't feel like I have that and I don't know if it is my fault or if it is my personality or if I am too pushy (Laura, Post-observation Follow-up Interview, 2/12/16).

As Laura continued to engage with others in the grade level group and observed the practices of the community, she learned to interact and participate as a new member of the community without making others feel that she was attempting to disrupt the status quo. It dawned on Laura, towards the latter half of the school year that preserving the status quo was something the group valued — change was difficult to come by, particularly, when it was being introduced by a "new" member. A reflection of a component of Laura's *active* ambitious mathematics teacher

identity was her excitement to share with the group what she learned in other professional development contexts (conferences/teacher trainings). Laura took it upon herself to include on the PLC meeting agenda allotted time to share what she learned at a conference or to share new resources that she came upon—Ex. online resources such as Fluency Digital Lab and Achieve the Core. Laura learned that the best approach to share new ideas with the group was to simply prepare the materials, share it, and then "drop it:"

> If there is an idea I am excited about, put it together and say to my co-teacher, hey I am excited about this. I was thinking about putting something together. What do you think about that? Then share it with the group so they know, hey I want to share this with you. If you decide you want to put your class, you are more than welcome to be in this class and then drop it (Laura, Post-observation Follow-up Interview, 5/24/16).

She learned that this approach would serve her better in the long run in regards to working collectively and cohesively with the other teachers. This was reflected in her response when asked during her last interview regarding what she learned about how to interact with her co-teachers: "I think, I am going to continue to try. I think that will serve me better." Laura needed to establish competence knowing how to participate as a new member of the community. Because Laura's mathematics teacher identity and the mathematics teacher identities of the majority of teachers in the community were in opposition, Laura had to learn how to mutually engage with others in a community that had differing views on mathematics without compromising her own identity:

> I feel like it is a more of let them come to it, let them come to the idea, let them like I can put it out there and say, this is what I am excited about, this is what I am doing and then

> if they want to come to that or if they want to say, oh I want to know more about that or I will try that our my class, let them do that (Laura, Interview, 5/24/16).

She found a balance between cultivating her *active* ambitious mathematics teacher identity and participating in her community.

Accountability to an enterprise. Laura's experience of interpersonal tension and "push back" in the kindergarten professional learning community is attributed to the differences in the level of commitment and understanding towards the goals of the mathematics professional development between herself and the teachers in her grade level community:

> The struggle I have is that because I have that personal goal for myself and I'm really committed to it and I'm the only one bringing it up like regularly but I'm also a new teacher so I want to respect the fact that in no way do I think, Oh I know better than all of you or you aren't doing a good job cause I think they're doing a great job. It's just that I…. I'm looking at this and I, I thought we were going to talk about it together more and it seems like after the PLC is done we had—[coach] came into this whole thing about learning goals for this math unit and like afterwards there was so much…like what I said before. [in reference to other teachers] Like why are we always talking about the learning goals, why are we always talking about the learning goal? My kids are learning it. I hit all those learning goals and what about this. I'm like, are you kidding me? Like okay well then maybe you have your learning goals so down that you don't need that so let me tell, let me just be clear for myself, I need that (Laura, Post-observation Follow-up Interview, 2/12/16).

Her level of commitment and engagement with the mathematics professional development was a reflection of her *active* ambitious mathematics teacher identity. She found value in the

professional development and felt accountable to all the expectations and processes, therefore, she was less conflicted of the time spent discussing mathematics. This commitment toward the expectations and processes of the "enterprise" was reflected during moments in which she directed the group's attention back to mathematics when discussions veered from this topic and when she took it upon herself to share with the group what she had learned from attending conferences and trainings outside of the school community. Her dedication toward mathematics professional development was a reflection of her mathematics teacher identity—one that differed from the mathematics teacher identities of the teachers in her kindergarten community.

Negotiability of repertoire. Laura's negotiation of repertoire was more pronounced in her experiences within the professional learning community because she was a new member of the community. As a new member to the community, Laura was unfamiliar with the repertoire of practices that were already familiar to the rest of the kindergarten community. Laura relied on her personal experiences (credential program/student teaching) to help make sense of the practices embodied by the community. Laura attempted to include her experiences to better the community by proactively wanting to share what she had learned or resources she had acquired through her participation in other professional development contexts. This effort to bring new ideas that were unfamiliar to the group became a way for Laura to establish her membership in the new community. When her ideas were not taken up by the community, Laura learned to adjust her approach to align more with the regime of experiences of the group. She continuously found herself negotiating her repertoire of practices to be more acceptable with the regimes of the kindergarten group and her co-teacher:

> For the most part, there are certain things that she really wants to take a lot of time on. Just like the "model city", she has a certain vision about it and certain things she wants

> done. I have been very hands off…Yeah I have because it is okay. I care about squeezing in those little facts wise things. I am going to make sure that happens. She cares about making sure whatever, whatever with the project like she has held that more and that is great. I think if I let her do her own thing, try to get here a little earlier, which I am not very successful in. I try. I think I was a little too pushy or maybe I was a little bit too I want it my way. I don't know. You know again, I have never co-taught before (Laura, Post-observation Follow-up Interview, 5/24/16).

This ultimately resulted in Laura becoming more of a peripheral participant within her kindergarten community and feeling more like a legitimate participant within the professional learning communities she became a part of outside of her school community.

I now turn my focus on the 5th grade community. In the next section, I elaborate on how the 5th grade community functioned as a group by describing the dimensions of competence that are embedded within the social practices taken up by the 5th grade team.

5th Grade Community

The 5th grade professional learning community was comprised of three teachers who shared instructional responsibilities between two classrooms. Although Claire split her time between two classrooms, she was very much recognized as a full contributing teacher in 5th grade. The 5th grade community was recognized school wide as an exceptional team. Both Heather and Lucy were founding teachers of the school and thus recognized as "veteran teachers." This reputation among the school community was well-received by Claire, who was told by other teachers that she was going to be joining "*the* team." Teachers' commitment to the school and all its impending projects and school wide goals were reflected in the teachers' active participation and dedication towards reaching the set goals. Heather's unique position in the

school as both a 5th grade teacher and being involved in many other school committees afforded her a level of access to school wide initiatives and future projects prior to when they were shared with the rest of the school community. Heather's role as grade level representative and school administrator allowed her to establish a stronger presence in the 5th grade community. Her leadership in the 5th grade team was very apparent within the professional learning community meetings: "…she's definitely the conductor there, like 'alright guys we're going to do this, we're going to do that' and that feels really good cause she has that strong presence, and everyone helps, everyone works" (Claire, Post-observation Follow-up Interview, 5/19/16). She took initiative to lead the group, and her leadership was appreciated and accepted by her co-teachers. The dimensions of competence that were established by the group are described below, followed by an account of Claire's experience with developing the dimensions of competence that allow her to participate in the 5th grade community.

Mutuality of engagement. The agenda that was shared with the group guided the structure and organization of the professional learning community meetings. Initially, the coach created the agenda; however, gradually Heather took over this responsibility. Everyone contributed to the topics that were included on the agenda and were instructed to add to it any questions or concerns they had prior to each meeting. Similar to the structure of PLC meetings from kindergarten, there was a time frame allotted for each topic or task on the agenda. Roles such as facilitator, note-taker, and timekeeper are established prior to each meeting. These roles provided a sense of structure regarding the expectations of how the meetings would be held. As protocols and unit planning processes shifted during the course of the academic year, teachers turned to Heather or the coach for direction. This was demonstrated during a PLC meeting when Heather took the initiative to address Claire's question:

Claire: I really don't understand how this is organized?

Heather: You have misconceptions (walks up to the board to assist), skills, and concepts.

In one particular segment during a PLC meeting in May, there was a lack of clarity regarding the correct coding of fluency facts for students. Heather took the initiative to explain to the group, in particular, to Claire, her understanding of the codes:

> So this is the difference then...you're collecting this data as kids are like doing an activity or playing the game. I'm not stopping them to be like "so how did you know that" so I can be like oh they're accurate but they took longer than 3 seconds to do it...and that's why the codes were different…(PLC Meeting , 5/24/16).

Heather generally had a firm grasp of understanding regarding the tasks and expectations given to them and this level of expertise did not go unnoticed by her grade level community. Thus, most times, questions would be directed towards Heather when the coach was not present. Heather took the initiative to answer questions when they were brought to the group or led the group when the coach was absent from the meetings. Heather's strong leadership role within the 5^{th} grade community was best reflected during a PLC meeting in April where the group utilized the protocol to analyze student data for the first time. She led the group through the process and read through the protocol so that everyone was clear on the expectations regarding the process of analyzing student work.

The community encouraged group collaboration and collective participation. This was best demonstrated during meetings in which teachers were collaboratively working on creating math problems for pre/post assessments. The attention to detail regarding the generation of problem types was apparent based on the lengthy discussions that took place. Teachers

brainstormed the context, numbers, and strategies that were involved in a problem. Often times, teachers even worked out problems to "test" out the numbers and to anticipate the strategies students might attempt in solving the problem. Quite frequently, during PLC meetings, where teachers were engaged in unpacking student strategies and anticipating student strategies, a large portion of the meeting time would be focused on actually writing out student strategies and discussing as a group the student thinking behind the strategies and how they should address them or utilize them within their lessons.

An expectation of the group was that problem types always needed to be connected to standards and learning goals and this was repeatedly mentioned during discussions. The rapport that was established between Lucy and Heather was very open and direct. The familiarity in the practices and processes of working productively with each other stemmed from their past experiences working together. Through the years, they had developed a level of trust and ability to critique each other. Collective participation was promoted within the community and became a familiar practice of the 5th grade team, especially between Lucy and Heather:

> …I work well with them--but I do know that I can be challenging at times, but we set expectations: like feel free to tell me if something is bothering you, or feel free to challenge me...cause as we get to know each other we try to have this relationship where we could critique one another but not be offended (Lucy, Post-observation Follow-up Interview, 12/27/16).

Both Heather and Lucy were cognizant regarding Claire's role as a new teacher in 5th grade and thus they recognized that at times they needed to be extra supportive with her learning of the practices and becoming familiar with the ways to engage and interact with each other. They made it a point to be aware of promoting an inclusive learning environment.

Accountability to an enterprise. Teachers of the 5th grade community were collectively invested in the mathematics professional development goals. They were committed to the "enterprise" and thus held themselves accountable to the standards and expectations placed on them in the context of mathematics professional development. However, it is important to highlight that their participation and engagement in the process of unit planning was not free of tension and frustration, but rather, teachers negotiated through these tensions because they were collectively committed to the goals of the mathematics professional development and towards improving their teacher practices. Their dedication and commitment to implementing the unit planning process with fidelity was reflected in the time that was dedicated to unpacking standards and student strategies. Teachers were very focused during the meetings on the task at hand (unit planning) and viewed their math time as a priority. Heather expressed this dedication and collective participation:

> ..like math was so intentional for us this entire year, the amount of time we devoted to it, the consistency, every single day of having our math block was very intentional and that's not necessarily true all the time. I feel like in the past and even here...other things might have suffered this year--but like you know, oh we'll just cut that today because we have project work to do or something like that, but there was no question about our math block (Heather, Post-observation Follow-up Interview, 5/31/16).

There were seldom times when conversations and discussion during PLC meetings were not mathematically focused (when it was clear that math would be the focus during PLC meetings) and much of the time this accountability to mathematics was led and guided by Heather. Heather received first-hand knowledge regarding school wide initiatives and her grade level team benefited from her having this level of access. Heather usually was able to explain and clarify

any questions related to mathematics professional development to her grade level community. During the course of the academic year, she helped facilitate two professional development sessions—a reflection of her leadership role within the school. Heather's dedication and commitment to the school came through in the ways she approached tasks, and this positive disposition to the "enterprise" trickled down to her grade level community.

Negotiability of repertoire. Teachers were in the process of acclimating themselves and developing confidence in the new shared repertoire of practices that guided the structure and flow of each of their mathematics lessons. They had to deal with negotiating their repertoire of practices when they were not receiving positive student assessment results. They had to negotiate some of the practices and processes when they were confronted with discouraging student learning outcomes:

> I think that happened in January when the kids came back and their fractions test was not so good. That was so eye-opening, it made us reflect, like how come we weren't reviewing this stuff more, how come we were just doing this day as this and this day as this, and what about our different groups (Claire, Follow-up Interview, 3/30/16)?

A particular PLC meeting held in January revealed teachers' concern with the trajectory of topics being covered. These concerns were shared as way to collectively discuss how to address the student learning gap that was arising in their teaching:

> Coach: So am I hearing that we need to do some area work with whole numbers?
>
> Heather: that's what it sounds like
>
> Lucy: No, I think we need whole number work with multiplication, not necessarily area…
>
> Claire: I'm thinking we need both…

Lucy: Yeah…we do…

Claire: yeah they do need to work with multiplication but the area was like a big…I think it was that extra layer today, with the fractions and the area on top of that was really challenging for them and I felt like they really needed a review or lesson, and so that's why I brought this today (resource) because I was kind of looking the area lessons and we were discussing maybe we need to…but then it felt like we were going to go off on this tangent with area when we were so focused on fractions…

Lucy, in particular, found students' discouraging assessment results as a reflection of their planning practices and was concerned with identifying the reason behind this outcome:

> I don't doubt my ability in doing math, but I really doubted my ability in teaching math because the kids were getting all these terrible assessment scores, and so when you have kids doing not well in your assessments, you're wondering 'ok i must have done something wrong' our plans must be faltered somewhere or I'm not presenting those plans the right way or I'm not assessing them the right way, and then for me to go home and think about new plans, and I'm trying to think 'oh man what if this is not good anymore (Lucy, Post-observation Follow-up Interview, 3/31/16)?

This process of negotiating repertoire of practices and experiences was also observed during meetings in which teachers' familiarity and experiences with teaching mathematical concepts came in conflict with standards and curriculum. One concern was the issue with teaching students how to divide decimals without using the standard algorithm—a practice that teachers have been accustomed to teaching and were now being told, that was not part of the standard in 5^{th} grade:

Lucy: I'm trying to figure out how to divide decimals without the standard algorithm in my head right now

Claire: you know what…I confess I got on the internet last night looking at the debate about algorithms and that was one of the big ones

Lucy: how do you divide decimals without the…

Claire: that was one of the big ones…for the arguments for the standard algorithm

Teachers rationalized and negotiated their own prior understandings regarding how to teach certain concepts and being accountable to the standards. This was reflected in Lucy's concerns: " I don't think standard algorithm is necessary, however, I think that we are in a certain place in our world where people are not ready to let go of it...I'm afraid that I'm sending them out not prepared." The 5th grade community also found themselves negotiating the flow and structure of their mathematics lessons when it occurred to them that the current math lesson structure was not providing students with enough structured time to practice procedural fluency or that during whole class share outs it was difficult to gauge whole class engagement:

> …so much of what we've done has been whole class and kind of coming into like again you kind of come to like this circle at the end and being like well if I had several more months I could so easily go back to like kind of more so, some whole class but some small group, and that's what we used to do, what I used to do very well, and prided myself on it, and then it kind of was like I have this idea like oh no it was supposed to be like this….I think how our lessons were planned out, you know most of it, and it wasn't just this year, it started last year with like CGI training, and thinking about how everyone should be benefiting from everybody's strategies and like having this idea of you do the problem solving and you do a share out and everyone's a part of that, and then the amount

of time that it took, you couldn't really do anything else (Heather, Post-observation Follow-up Interview, 5/31/16).

Teachers negotiated and rationalized the ways they could re-structure the math lesson structure to address the student learning needs. They negotiated their practices to include more opportunities for practice and differentiated groups, because they felt their students needed them.

The "veteran" teachers in the 5th grade community were cognizant in their efforts to create an inclusive learning environment for their newest member, Claire. During moments in which they were confronted with topics or processes that conflicted with their previous practices and when they discovered that students were performing poorly on their assessments, they took the time to express these concerns and tried to come up with resolutions and alternative practices that they all could agree upon.

In the next section, I focus on the case of Claire. Claire was considered a novice teacher as well as a new teacher to the 5th grade community. Her mathematics teacher identity fell along the same range along the spectrum as compared to her co-teachers. The similar range of mathematics teacher identities that reflected the 5th grade community proved to be an asset towards Claire feeling like she "belonged" in the community. Claire's *active* ambitious mathematics teacher identity influenced the ways she participated and learned with the 5th grade teachers. I now turn to the case of Claire and describe her experiences with developing the dimensions of competence to participate and interact with those in the 5th grade community.

The Case of Claire

Claire's *active* ambitious mathematics teacher identity had an influence on her participation and engagement in mathematics professional development with her 5th grade community. Her commitment to develop her mathematics capacity and practices as a new

teacher came through in the ways she engaged in the professional learning community meetings. When she did not agree or understand something she did not hesitate to ask questions. The group discussions that resulted because of her questioning allowed her to negotiate and adjust her thinking to be more aligned with the shared repertoire of practices of the 5th grade community. Her participation and learning within an inclusive and supportive group allowed her to develop the dimension of competence that embodied the 5th grade community. Claire was able to engage in practices that supported her mathematics teacher identity because her co-teachers had similar views on mathematics and shared commitments to professional development. Her interactions and participation with the 5th grade team influenced her development of competence in the dimensions of mutuality of engagement, accountability to an enterprise, and negotiability of repertoire. Claire's experiences with developing competence in each of these dimensions are described below.

Mutuality of engagement. Claire was well aware of the school-wide perception associated with the 5th grade team prior to coming on board as a new teacher in the grade level. She already had great admiration of the two teachers she would be working with and this positive perspective was further reinforced when speaking to other teachers and her own interactions with the 5th grade team. Claire described the 5th grade team as having a "can-do attitude" and being very "dependable:"

> I want to say 'can do' attitude, like we can do it, and we're going to figure it out, and the second one is dependable--like I think that if we get something and it's going to be expected that we do it, then we're going to make it happen--and hardworking (Claire, Post-observation Follow-up Interview, 5/19/16).

She perceived the 5th grade team as a group of teachers who would always strive to meet expectations and would work hard together to achieve the expectations placed on them. This shared mutual accountability and engagement to the work and to each other created a comfortable learning space and atmosphere for Claire, which allowed her to feel at ease with asking questions and checking for clarity. Moreover, her positive mutual engagement with her co-teachers led her to admire the work ethic of others and motivated her to try to do more:

> I love my team, I really love them, I love..I want to emulate them in some ways, like I really have been positively influenced by them --like I told Heather once, I said 'Heather, you say yes to everything' she does--she says yes to everything and she always makes it work, and I don't know--She has a lot on her plate--I don't know if I can be that way to say yes to everything but I am impressed with that, that that's a way that works for people (Claire, Post-observation Follow-up Interview, 5/19/16).

Group collaboration and collective participation became practices routinely seen during professional learning community meetings. It was expected that teachers shared their views and ideas routinely during the process of unit planning. Claire actively participated in the process sometimes as a peripheral participant—focused on listening and learning from others. She expressed that she attributed her "novice" status to be conducive to her learning and being able to mutually engage with the expectations of the community because as a new teacher she was fully invested with learning from others:

> ..feel ok with it, I think it's because I don't have a lot of experience, a spectrum, I'm open to learning new things and if they say this is a good way to do it and I see, like I feel good, I'm comfortable...I'm comfortable with that habit now, because that's been a new habit for me. If i had had years of experience and had to change everything I can see how

there would be...like you would looking for things like this was better then, but the good thing is I'm kind of new so…(Claire, Post-observation Follow-up Interview, 2/4/16).

The group discussions that also took place while teachers analyzed student work helped to illustrate how the teachers worked together. They rationalized and presented "next steps" collaboratively and shared the student dialogue they engaged in during the lesson to further analyze student thinking.

Claire's positive experience in learning the ways of how to participate and mutually engage with the members of the 5th grade community was partly due to the efforts of the 5th grade teachers in wanting to support Claire in feeling included and a member of the community:

> Heather and I always talk about to make sure that Claire feels welcomed, Heather and I, we talk really fast to each other, cause we worked together for so long, so we have to slow it down--you know certain things like that--sometimes if we notice something about Claire that the other person didn't notice, then we'll tell each other so that we're both in aware--so we kind of make sure that all 3 are equalized, and welcomed and feel welcome (Lucy, Post-observation Follow-up Interview, 12/27/16).

The 5th grade teachers were aware of Claire's transition into a new grade level and learning the practices and ways of the group. This receptiveness was also felt by Claire and thus, she felt very welcomed and included with her new grade level community:

> I genuinely felt welcomed and I was genuinely happy to be part of this team and it felt really good and that just kind of built, like just these positive things built--and every once in a while there was a little 'ehh' but overall I don't know it's been..I don't know what to tell you--I think Heather and Lucy have very open welcoming personalities and I don't know if everybody has that, so I can imagine another group of 3 not having those same

> dynamics and I really love working with a team…I love it when we all work together, so that's really important to me that we have good communication (Claire, Post-observatio Follow-up Interview, 5/19/16).

Claire, Heather, and Lucy all fell on the *active* side of the ambitious mathematics teacher spectrum, signifying that they had similar views regarding the importance of learning mathematics and similar views regarding pedagogy and professional development. This shared understanding afforded teacher participation to be cohesive and collaborative.

Accountably to an enterprise. Claire's commitment and accountability to the goals of the mathematics professional development were a reflection of her mathematics teacher identity. This commitment towards professional development was also shared by her co-teachers. Given that the 5th grade community all shared a strong commitment towards improving their mathematics understanding they were "on-board" with engaging in the practices of developing a shared system of unit planning:

> I look back and I think…and I also think we should reflect more to really process what we've learned but I actually think that being challenged to think about things has been helpful--to break down the standards, and again it's not something that I like to do, but I think it's helping to lay a foundation for a mathematical understanding that wouldn't be there, if we hadn't done all of that intense, thoughtful work (Claire, Post-observation Follow-up Interview, 5/19/16).

Teacher accountability towards implementing the planning process with fidelity was evident during moments when questions were directed at making sure they were going through the process the way it was intended to be. Claire, in particular, was very aware of the importance of the protocol to unit planning and wanting to stick to the process with fidelity. Her concern

with engaging in the process with fidelity was shared during a short break in the middle of one of their PLC meetings in February. She reflected back to the group experience in the unit planning process during the previous PD session, and expressed that she felt the dynamics then differed from the process they were engaging in now. She was concerned with not accurately going through the process as it was intended.

Claire's accountability to the goals of the professional development could be observed based on her engagement in the various professional development tasks assigned. She was always part of a very supportive team that was also invested in the "enterprise" and therefore the guidance received during the PLC meetings ultimately was supporting teachers to meet the goals.

Negotiability of repertoire. Given that Claire was a novice teacher and she was transitioning into a new grade level, she found herself adjusting her own repertoire of practices and mathematical understandings to the regime of practices promoted by the 5th grade community. Claire's approach to negotiating her repertoire of practices and knowledge was through asking questions and by taking more ownership in her own learning:

> That was where I recognized that I wasn't feeling comfortable with it, so I volunteered to do the whole volume unit and then I did 5 problems and I took all weekend to do them and I was like omigosh this is harder than I expected, and then we all worked together, and it worked out fine--I took a lot more ownership and I enjoyed it (Claire, Post-observation Follow-up Interview, 3/30/16).

She was open to new ideas but before she was able to adjust her thinking she needed to be able to make sense of it and to see concrete support in the argument. A key example that highlights this process of negotiation centers around Claire's views on the trajectory of teaching particular mathematical concepts and strategies. This was observed during PLC meetings when discussions

focused on why they no longer taught certain concepts or strategies (i.e. algorithms, LCD) in the 5th grade. By analyzing the trajectory of learning standards promoted in the 5th grade, Claire made adjustments to her understanding of the learning trajectories promoted by Common Core and interpreted the rationale behind these changes.

The different dimensions of competence embedded in the social practices of a grade level community were influenced by the mathematics teacher identities that reflected the majority of teachers in the community. Claire's and Laura's individual experiences in developing the competence to participate and interact with the teachers in their respective grade level communities provided insight regarding how learning within a community required an alignment between community and personal goals. Furthermore, the personal goals linked to mathematics professional development are critical features of mathematics teacher identity.

CHAPTER 6

Discussion and Conclusion

Current mathematics reform efforts call for students to engage in rigorous content work that is aimed at developing their procedural and conceptual understandings of mathematics (CCSS, 2010; NCTM, 2001). This reform in mathematics teaching creates considerable changes in teacher practices and understanding of what it means to *do* mathematics. Therefore, professional development becomes an important resource in providing learning opportunities that will support teachers to develop a new vision of mathematics teaching (Beauchamp & Thomas, 2009, 2011). Mathematics teacher identity contributes to how teachers come to understand their role in the classroom, how they make sense of what it means to be a reform-based mathematics teacher, how teachers make decisions regarding practices, and how they participate in professional development (Battey & Franke, 2008; Grootenboer & Ballantyne, 2010;Van Zoest & Bohl, 2005).

In this study, I sought to explore the construct of mathematics teacher identity and to utilize that construct as a lens to better understand the relationship between mathematics teacher identity and teacher experiences and participation in professional development. I grounded my study within the mathematics teacher identity framework proposed by van Zoest and Bohl (2005) who emphasized the need to factor in both aspects of mind and community when studying the mathematics teacher identity development. Their framework brought together two interacting and overlapping components related to the individual (cognition) and the social (community) (refer to Figure 2.1). The findings from this study highlight the role that mathematics teacher identity has on teacher learning and participation within professional development. The variation in mathematics teacher identities were found to be related to how teachers responded to

challenges and negotiated through tensions. The findings from this study also contribute to the literature on professional development in that it provides evidence to support the notion that professional development that is aimed at supporting teachers in developing a vision of ambitious mathematics teaching should take into consideration the mathematics identities that teachers currently exhibit as they begin professional development. Furthermore, the findings from this study highlight the importance of community influences and thus suggest that professional development programs need to recognize what practices and norms are being supported in these PD settings and how these environments afford or limit the opportunities for identity development. Lastly, the findings from the study shed light on how mathematics teacher identity has a role in the ways teachers negotiate through their experiences when trying to develop the necessary competence needed to participate in a new grade level community.

In the next section, I discuss these findings and situate them within the literature on mathematics teacher identity, teacher learning in professional development, and communities of practice.

Mathematics teacher identity and negotiations of tensions. Mathematics teacher identity is an essential construct through which to understand teachers' experiences negotiating through the tensions that arise within their practices in the context of professional development. The literature on mathematics teacher identity contends that teacher identities are shaped by political, social, and institutional forces. These forces influence and dictate the systems, structures, and discourses that are in place in schools and which influence the ways teachers view and teach mathematics (Brown & McNamara, 2005, 2011; Neumayer-Depiper, 2013; Walshaw, 1999).With these multiple forces at work teachers will inevitability experience tension and

experience conflict as well as ambiguity as they find their footing in the profession (Horn, Nolen, Ward, & Campbell, 2008; Windschitl, 2002).

This was most evident in the ways the kindergarten teachers responded to the requirements and protocols in relation to unit planning. Teachers struggled with seeing how the new process was impacting their practices and student learning outcomes; especially when they perceived that their students in the past were progressing further along as compared to their current students. This finding was consistent with studies on teacher tensions. When teachers' lived experiences conflict with the expectations that are placed on them tensions will arise (Cherubini, 2009; Smagorinsky, Cook, Moore, Jackson, & Fry, 2004). It is important for schools to provide professional development that will support teachers with navigating through the varied discourses and demands that are placed on them within the profession.

Within their mathematics teacher identity framework, Van Zoest and Bohl (2005) contended that an individual's perception of self and others' perception of self within the community were important components related to a teacher's identity. Thus, a key aspect of a teacher's identity was related to how teachers perceived their position within the community as well as how they perceived others' perception regarding their position in the community. The findings from this study support this conception. The roles teachers took on and how they were positioned by others in their grade level community influenced the approaches they took to negotiate their tensions. For example, it was evident that teachers positioned to be "veteran" teachers in the community had a more developed rapport with administration and thus were more comfortable with sharing their ideas and concerns with them. Furthermore, as legitimate participants in their professional learning community they did not find the need to have to seek outside support networks because they were able to find them in their PLC. Whereas, in the case

of Laura, who was positioned as "new," sought out other avenues outside of her PLC to negotiate tensions. Her *active* mathematics identity differed from the *passive* mathematics identity of her co-teachers and thus the PLC was not generative for her learning.

Mathematics teacher identity as tied to community. The analysis of the relationship between the mathematics teacher identity that the teachers in this study came to take on within their professional learning communities and their experiences with negotiating the tensions that arose in the context of mathematics professional development suggests the potential role that a professional learning community has to becoming learning spaces that was generative in teachers' learning and development. It was in those spaces in which teacher tensions arose in response to the expectations placed on them. However, due to the varied mathematics teacher identities within the community, there were missed opportunities for collegial partnership, collective participation, and critical colleagueship (Hodgen & Askew, 2007; Lord, 1994; Smagorinsky et al., 2004). This was most evident in the case of Laura and her kindergarten PLC. Laura's mathematics teacher identity differed from the mathematics teacher identities that her co-teachers took on within the learning community and this variance attributed to the lack of a shared vision of community goals within the kindergarten PLC. The lack of a shared vision of community goals among the teachers in the PLC further created tensions in relation to institutional factors which stemmed from tensions related to perceptions of lack of agency in decision-making regarding practices, curriculum use, and meeting reform-based expectations (Achinstein & Ogawa, 2006; Drake & Sherin, 2006; Olsen & Sexton, 2009; Sandholtz, Ogawa, & Scribner 2004).

The tensions and conflicts that arose due to the misalignment between PLC goals established in the kindergarten grade level and the mathematics professional development goals

were consistent with research that speak to the fact that when there are inconsistencies in practices and beliefs across different communities, how teachers choose to participate *within* and *across* the communities will be influenced by their mathematics teacher identities and communities they take part in (Alsup, 2006; Handley, Sturdy, Fincham, & Clark, 2006; Hodges & Cady, 2012; Hodge, 2006). Teachers must go through the process of reconciling and negotiating conflicting ideas drawn from different communities. For instance, Laura's *active* ambitious mathematics teacher identity differed from the *passive* ambitious mathematics teacher identities that her co-teachers came to take on within the Kindergarten PLC. This disparity resulted in Laura having to negotiate the repertoire of practices and accountability to an "enterprise" that connected to her mathematics teacher identity with those connected to the kindergarten grade level community. Laura reconciled and negotiated these tensions by seeking out other communities that had a vision of mathematics teaching and learning similar to hers. Whereas in the 5th grade PLC, the mathematics teacher identities that reflected the 5th grade teachers all fell along the *active* range of the spectrum. Similar mathematics teacher identities proved to be an affordance towards Claire's continued cultivation of her mathematics teacher identity. She worked towards appropriating the repertoire of practices within her PLC because she and her colleagues had a shared vision of mathematics teaching and learning as well as a shared accountability to the "enterprise."

The different "enterprises" in which teachers in kindergarten and 5th grade perceived themselves to be accountable toward raises questions as to what teachers value as being important practices and learning experiences for students particular to a grade level. For example, teachers might perceive "play" to be a crucial component in supporting student development and learning in kindergarten, as opposed to 5th grade, and therefore, would invest

more time dedicated to creating learning experiences to support students' social development more as opposed to other academic subject matters. That is, within the kindergarten grade level, there might be other developmental learning concerns that teachers perceived to be critical in the context of that age group. How teachers in the two grade levels responded to the goals of the mathematics professional development could in fact be a reflection of their perception with the learning concerns particular to the age group connected to the grade level.

The different teacher experiences due to varied mathematics teacher identities within a PLC contribute to the literature that looks at the potential affordances and hindrances of learning among teacher colleagues and using teacher community as a specific context and resource for teacher learning and development (Cochran-Smith, Feiman-Nemser, McIntyre, & Demers, 2008; Horn & Little, 2010; Kruse, Louis, & Bryk, 1995; Westheimer, 2008). Laura had to seek out colleagues outside of her community to support her learning and professional development, whereas Claire was able to learn among the teacher colleagues within her PLC at the school.

Mathematics teacher identity was not only found to be influential in the experience and negotiation of tensions for teachers, the construct was also found to be linked to the dimensions of competence embedded in the social practices of a grade level community. Mathematics teacher identity holds a rather important role when trying to understand the ways in which new members learn to participate within a community of practice (van Zoest & Bohl, 2005). The findings in this study offer evidence that support the notion that the modes of participation or dimensions of competence within a community are cultivated by the mathematics teacher identities that reflect the majority of teachers in the community. Laura and Claire's mathematics teacher identity informed the ways in which they approached and participated in the social practices embodied by their respective grade level community. For example, the ways that they

participated and interacted with others in their PLC were a reflection not only of their mathematics teacher identity but also to the ways they were positioned in their PLC. That is, the different roles or ways in which teachers were positioned within the PLC and the school influenced their interactions and relationships with each other (Davies & Harre, 1990; Harre, 1999). Thus, how teachers were positioned by others in the community had an influence on their participation and engagement with communities of practice as well (Handley, Sturdy, Fincham, & Clark, 2006). A focus of concern is to be able to develop competence in the norms and practices that are upheld in the different communities they participate in and to be viewed as a competent member.

Teachers are tasked with the challenge of being members of different communities within the teaching profession. Gee (2000, 2001) professed the notion that the construct of "identity" is to be defined as being a certain "kind of person" in a given context or community (p.99). In any given context, a community of individuals will engage in certain social practices and norms that are reflective of the community. For an individual to be recognized as having an identity that is reflective of the norms and practices of the group requires the individual to be the "kind of person" who engages in the practices and norms of the community—they must develop competence in how to participate in the practices and norms of that particular community. Laura and Claire, as new members in the community, had different experiences in their development of competence within their respective grade level communities. Their different experiences highlight the learning outcomes when there is alignment *and* lack of alignment between identity and commitment to an "enterprise." These findings suggest that how teachers participate in different communities is shaped by context as well as whether or not there is a commitment to a

shared "enterprise" among the teachers within that learning environment (Lave & Wenger, 1991).

Situating mathematics teacher identity in the broader context of professional development. Although the analysis of the design of the professional development was beyond the scope of this study, the analysis of teacher experiences within this mathematics professional development offer suggestions regarding types of structures and implementation of learning experiences that could support generativity of productive mathematics identity. One of the most critical features within this professional development design was the inclusion of coaches. The coaches served an important role, as having to bridge the concepts and practices between classroom and professional development. Given that teacher learning occurred within multiple contexts in and outside of school (Borko, 2004), having a coach that traveled between classrooms, PLC, and professional development sessions was a great asset towards supporting teachers in their learning. The coach had the potential to become an important resource for teachers especially during moments of tensions. However, the coaches' perceived resistance to particular components of the professional development, in particular, the unit planning process, would manifest itself during PLC meetings with the teachers. This resistance was perceived by teachers as a lack of a united front by administration and coaches. The ambiguity regarding the goals of the professional development thus persisted.

There were missed opportunities for critical colleagueship—productive disequilibrium and collective generativity—(Lord, 1994) within the PLC because the role of the coach was not explicitly given and moreover the coaches themselves were not provided adequate support and training with regards to what it meant to be a "coach" in this context. The facilitation of a learning space that promoted critical colleagueship within PLC, by the coaches, what Lord

(1994) referred to as "productive disequilibrium," had the potential to support the development of mathematics teacher identity because within these structured learning spaces teachers could negotiate their prior understandings with new ideas. Within the context of professional development, teacher perception and feelings of ambiguity and conflict are not uncommon and could become opportunities for collective generativity—where members of a PLC are collectively committed to the goals of the PD despite feelings of ambiguity and conflict (Lord, 1994). The evolving nature of the professional development design was not properly understood by either the coaches or the teachers as the year progressed. Due to the lack of communication between the different levels—administration, coaches, teachers---the ambiguity and conflict that arose resulted in teachers and coaches being increasingly more resistant to the expectations given from the PD as well as being less committed to the goals of the professional development and overall "enterprise."

Implications

The findings from this study have implications regarding teacher learning and professional development design. Consistent with the studies that find that teacher learning and engagement in professional development are "greatly enriched" when professional development attends to teacher practices or directly related to the work of teaching (Ball & Cohen, 1999), the immense time investment that was placed on mathematics unit planning during PLC meetings were not perceived to be "greatly enriched" due to the fact that teachers failed to see how the process was impacting their teacher practices in the classroom. Moreover, when teachers were unable to detect immediate positive student learning outcomes, they began to develop resistance to the unit planning process and expressed that time could be better spent on tasks that they perceived would directly impact their daily teaching practices (i.e., modeling of lessons, math labs). Thus,

the learning opportunities that are embedded within professional development need to be meaningful and applicable to the daily practices of teachers, especially for novice teachers who are cultivating their teacher identities (Jong, 2016).

The findings also highlight the important role that mathematics teacher identity has in relation to teacher learning and participation in PLC. Based on the notion that mathematics teacher identities can influence the ways teachers perceive, learn, and take up new practices, one area of focus for teacher education should concern supporting teachers in being reflective on the ideologies and experiences that informed their mathematics teacher identity. It is important for pre-service and novice teachers to become familiar in the process of critically reflecting on how to negotiate new experiences and practices with their prior experiences and knowledge (Hodges & Cady, 2012; Jong, 2016). This process of negotiating among different repertoire of practices will consistently be a process teachers must engage in within the teaching profession (Alsup, 2006). Building a conception regarding how to function and participate in a community where there is ambiguity and conflict can help prepare novice and pre-service teachers with the realities of working in the teaching profession (Lord, 1994). Thus, teacher education, teacher preparation programs, and induction programs should consider highlighting and deconstructing this process early on in order for teachers to become familiar and more aware of the possibility of having to negotiate their repertoire of practices when confronted with new communities of practice.

Laura and Claire's experiences transitioning into a new community and the tensions that they experienced reflect the need to provide teachers with the knowledge and skills to navigate through the modes of participation within communities without compromising the ideas and identities that they are coming in with. Their experiences speak to the importance of how members within a community can either hinder or be generative to a teacher's learning and

identity development. The variation of mathematics teacher identities in each of the grade level communities influenced how teachers approached discussing and working on areas of need (i.e. unit planning process). Similar to Horn and Little's (2010) findings that group characteristic conversational routines afforded different opportunities for learning; the mathematics teacher identities that reflected a grade level group or community were linked with how teachers responded to the opportunities to learn within the community. It is important that teacher education, teacher preparation programs, and induction programs address the challenges of what it means to become a new member of a community and how to successfully navigate through the tensions that will arise as they find their footing within the teaching profession (Pillen, Beijaard, & den Brok, 2013).

Lastly, an important implication to this study is the notion that it provides a lens to understanding the influential role that community and context have in shaping teacher learning and subsequently teacher identity. Given that communities can and do reflect commitments to different "enterprises." A teacher identified as "passive" in one community could very well exhibit a more "active" identity in another because her vision and goals are more aligned with the "enterprise" of that community. This raises questions regarding how to effectively support teachers with navigating through different communities and building commitment towards a shared "enterprise."

Limitations

Although the findings from this study contribute to research on mathematics teacher identity and teacher learning in professional development, there are limitations. One limitation is that the findings from this study only focus on two grade levels. It does not draw from the teacher experiences of other grade levels, which may reflect a different set of tensions and

mathematics teacher identities. Therefore, the findings from this study are not generalizable to all elementary teacher experiences in the public school setting or charter school setting.

A second limitation of this study is that it does not include the analysis of the coaches' experiences. The coaches proved to be a critical component in the facilitation of teaching and learning within the PLC meetings. Given that the inclusion of coaches within this professional development design was to facilitate teachers weekly in their development of reform-based mathematics understanding and practices, the coaches' perspective would have provided a more robust understanding regarding how the design of the mathematics professional development impacted teacher experiences. Moreover, the analysis of the coaches' mathematics teacher identities and how they informed the their understandings of the goals of the mathematics professional development would have provided an additional lens to understanding why there was resistance experienced by them early on and how it tricked down to the teachers.

Lastly, this study did not look into teacher classroom practice. A productive area of inquiry would have been to examine the nature of mathematics teacher identity entering PD, how that identity informed how they participated in this context, and the extent to which teachers attempted to put into practice what they learn in PD. However, due to the evolving nature and components of the PD design not being implemented as planned, the analysis of teacher practice in this context was considered not worthwhile given that the practice portion of the PD did not come into fruition as it was intended. The math labs and focus on teacher practices (outside of unit planning) was not consistently and explicitly addressed during the course of the professional development.

Conclusion

During this critical period in mathematics reform, when the vision of mathematics teaching in the U.S. and the expectations for learners of mathematics are changing, it is essential for educational researchers to consider the important role that mathematics teacher identity has in relation to developing this new vision of mathematics teaching and learning. This study draws from a socio-cultural perspective and situative learning theory (Lave & Wenger, 1998; Van Zoest & Bohl, 2005) to broaden our understandings regarding the relationship between mathematics teacher identity and teacher participation in professional development. The findings from this study bring to light the complexities of mathematics teacher identity, how participation within communities of practice and the experience and negotiation of tensions inform the continuous cultivation of a teacher's mathematics teacher identity. If we hope to move teachers towards developing a vision of ambitious mathematics teaching, we must recognize the lived experiences and personal narratives that inform the mathematics teacher identity and consider them to be resources when designing professional development experiences within professional learning communities.

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Appendix A

Teacher Life Story Interview Protocol

Teacher: Grade: Years teaching:

Interview Date:

Teacher Background:

1. Tell me a little bit about yourself.

2. What is your schooling experience as a child growing up?

3. What was your favorite subject in school? Why?

4. Describe your favorite teachers, Describe your least favorite teacher

5. If someone would describe you as a student, how would they describe you?

6. What is the purpose of education?

7. Why is learning mathematics important?

8. How would you describe the current education system? In your opinion, what is the most critical issue at the moment?

9. If you could have chosen another profession besides teaching, what would it be and why?

Motivation to become a teacher:

1. Why did you decide to become a teacher? (What made you decide to become an educator?)

2. What do you enjoy most about teaching?

3. What aspect of being a teacher do you NOT like?

4. What is your role as a teacher? As a mathematics teacher?

5. Which subject(s) do you feel the most confident in teaching? Least confident? Why?

6. What is your favorite subject to teach, why?

7. What is your least favorite subject to teach, why?

8. Which subject do you spend the least amount of time preparing for? The most amount of time?

Perspectives on Teaching Mathematics:

1. What experiences do you consider to have contributed most towards your understanding of mathematics teaching, and how you currently teach? Why?

2. What type of learning opportunities do you consider to be the most conducive towards student learning of mathematics? (drill practice, word problems, working together)

3. In which areas of mathematics learning do you feel your students feel most/least challenged in?

4. Which areas/topics of mathematics do you feel the most confident teaching? Least confident teaching?

5. What does ambitious mathematics teaching mean to you?

6. What does reform-oriented mathematics mean to you?

7. What is Common Core?

8. What preparation have you had concerning Common Core?

9. What were your first thoughts regarding Common Core mathematics reform?

10. What has been most challenging aspect of current mathematics reform? What helped you become more familiar with the new changes?

Acquired from Drake, Spillane & Hufferd-Ackles (2001) based on McAdams (1993)

"This is a story about your life experiences with mathematics. Teachers lives vary tremendously and they make sense of their own mathematics experiences in a variety of ways. Our goal is to begin the process of making sense of how teachers interpret their own mathematics experiences. Therefore, we are collecting and analyzing the stories of teachers' experiences with mathematics and looking for significant commonalties and significant differences in those stories that people tell us" (Drake, Spillane & Hufferd-Ackles, 2001, p.19).

Critical Events:

1. Peak experience—high point in your story about mathematics in your life

Consider these examples:

> "It would be a moment or episode in the story in which you experienced extremely positive emotions; like joy, excitement, great happiness, uplifting, or even deep inner peace after some mathematics experience. Tell me exactly what happened, where it happened, who was involved, what you did, what you were thinking and feeling, what impact this experience may have had upon you, and what this experience says about who you were or who you are now as a teacher."

2. Nadir experience—low point in your experiences with mathematics

> "Thinking back over your life, try to remember a specific experience in which you felt extremely negative emotions about mathematics. You should consider this experience to represent one of the 'low points' in your mathematics story. What happened? When? Who was involved? What did you do? What were you thinking and feeling? What impact has the event had on you? What does the event say about who you are or who you were as a teacher?"

3. Turning point—episodes through which a person undergoes substantial change.

> "I am especially interested in a turning point in your understanding of mathematics. Please identify a particular episode in your life-story that you now see as a turning point. If you feel that your mathematics story contains no turning points, then describe a particular episode in your life that comes closer than any other to qualifying as a turning point."

4. Important childhood scene—describe a memory about mathematics from your childhood that stands out in our mind as especially important or significant?

> "Now describe a memory about mathematics from your childhood that stands out in your mind as especially important or significant. It may be a positive or negative memory. What happened? Who was involved? What did you do? What were you thinking and feeling? What impact has the event had on you? What does it say about who you were? Why is it important?"

5. Important adolescent scene—describe a specific event from your adolescent years that stands out as being especially important or significant with respect to mathematics

> "Describe a specific event from your adolescent years that stands out as being especially important or significant with respect to mathematics."

6. One other important scene—describe one more event, from any point in your life, that stands out in your memory as being especially important or significant with respect to mathematics

Life Challenge:

1. Greatest Challenge

> "Looking back over your life and interactions with mathematics, please describe the single greatest challenge that you have faced. How have you faced, handled, or dealt with this challenge? Have other people assisted you in dealing with this challenge? How has this challenge had an impact on your experiences with mathematics?"

2. Influences on the Life Story: Positive and Negative

Positive—"looking back over your life-story, please identify the single person, group of persons, or organization/institution that has or have had the greatest positive influence on your perspective of mathematics."

Negative—"please identify the single person, group of persons, or organization/institution that has or have had the greatest negative influence on your perspective of mathematics."

Alternative futures for the life-story

1. **Negative future**---please describe a negative future.

"Please describe a highly undesirable future for yourself with regards to your interactions with mathematics, one that you fear could happen to you but that you hope does not happen."

2. **Positive future**—please describe a positive future.

"That is, please describe what you would like to happen in the future with regards to your interactions with mathematics, including what goals and dreams you might accomplish or realize in the future."

Appendix B

Teacher Questionnaire

Name: **Grade Level:**

1. Which 3 words would you use to describe your mathematics teacher identity? Please also include an explanation as to why you chose each term.

2. What experiences have influenced your math teacher identity?

School Context and Culture

1. Which 3 words would you use to describe this school? Why?

2. Which 3 words would you use to describe the teaching staff?

3. What was your first impression regarding the school environment? Has that impression changed?

4. Do you feel this school has limited resources? If so, in which areas?

5. Do you feel comfortable with asking colleagues, principal for help? Why or why not?

6. How would you describe your professional relationship with the coaches/mentors provided at school?

7. What is the role of the coach/mentor?

8. So far in the school year… have you encountered any tensions/conflict or issues that came about in the context of mathematics teaching? (Common Core, PD, PLC meetings, coaches, co-teaching, collaboration, etc.) Please elaborate.

Teacher preparation

1. Which credential program did you graduate from? Why did you choose this particular program?

2. Why did you choose multiple subjects program? (Elementary teaching)

3. If you could describe the programs' main goal, what would it be? (ex. Reaching all learners, differentiation, collaboration, equity)

4. What influence did the program have on you as a teacher now?

5. What do you remember from your methods course in mathematics?

6. Which instructor made a lasting impression on you? Why?

Appendix C

Post-PD Questionnaire

Teacher: Grade:

Session Date: Session Topic:

1. What is the most important thing you learned today?

2. In what ways did you find this session to be helpful? If you did not find it particularly helpful please explain why.

3. What questions do you still have in relation to today's session?

4. Please indicate and explain the types of tensions you have experienced recently OR are currently experiencing in relation to your role as a teacher of mathematics. (ex. Tensions could arise from: math PD, PLC meetings, Parents, Planning, Student behavior, grade level team issues, administration, coaching, etc.)

5. What approaches have you taken to resolving those tensions?

Appendix D

Post-observation Follow-up Interview 1

Part A: Focus on Lesson and Learning objective

1. How do you think the lesson went? (Did anything go not as planned?)

2. What was your lesson objective? Do you feel you met the learning goal? How do you know? (evidence)?

3. Open questions drawn from observations (try to get insight of the reasoning behind the choices that are made)

Part B: Perceptions Common Core and PD influences on Teaching mathematics

1.Was there any part of your lesson plan and/or practices influenced by what you learned in PD thus far? If so, can you explain how? If not, why not?

2. How has your practice changed from before? What do you attribute as being the reason for this change?

3. What are your feelings regarding Math PD so far? Do you find it helpful (not helpful)? What aspects have been helpful? What are your perceptions regarding how other teachers are experiencing PD and PLC meetings?

4. How do you perceive the role of a coach? What expectations do you think the coach has for your grade level team?

5. Are there any expectations coming from the coach, PD, Common Core and school that you perceive as being difficult or challenging to meet?

6. What has been most helpful to you in helping with your mathematics practices (i.e., with lesson construction, teaching practices, assessments) –how and why?

7. How would you describe your co-teacher? How would they describe you as a co-teacher?—how do you like having a co-teacher—what makes it great, what makes it challenging

Part C: Tensions and Negotiations

1. In the past month, have you encountered any tensions or issues that came about in the context of mathematics teaching? (Common Core, PD, grade level meetings, Coaches)

- If so, have you resolved them?
    - If teacher answers YES: How did you resolve them? (i.e., seek out help, went online, talk to math coach?)

- If teachers answer NO, explore why not?

2. What are some of your concerns regarding student learning at this point in time? (I.e., technology, limited preparation time, assessments)

3. Currently, in which areas would you like more support in? (i.e. talk moves, discourse, 5 practices)

Appendix E

Post-observation Follow-up Interview 2 Protocol

Part A: Focus on Lesson and Learning objective

1. How do you think the lesson went? (Did anything go not as planned?)

2. What was your lesson objective? Do you feel you met the learning goal? How do you know? (evidence)? What are your next steps?—

3. What part of the unit planning was this lesson taken from?

4. Is there anything in the lesson that wasn't planned—but you decided to make some changes in the moment?

4. Open questions drawn from observations (try to get insight of the reasoning behind the choices that are made)

Part B: Perceptions

1. What type of math learner are you? Is it any different of the type of math learner you are now as a teacher? (relationship with mathematics—mathematics just makes sense, memorizer, meaning makers, no access, …..)

2. Which area of math teaching do you feel you need more support in? (content, actual teaching, accessing student thinking, responding to student thinking, next steps, etc.)

3. Were there any parts of your lesson that were influenced from what was learned in PD/PLC meeting?

4. What are your perceptions regarding how children best learn mathematics? (pedagogy domain)—which areas do you think your students are struggling in?

5. When you work on these unit plans—where do you mostly draw your content knowledge from—how you learned it, how you previously taught it, or common core way? (content knowledge)

6. How have the ways you are teaching math *now* differ from what you did before?

Part C: Tensions and Negotiations

1. What do you perceive a tension to be?—in other words how would you define a tension?

2. In the past month, have you encountered any tensions or issues that came about in the context of mathematics teaching? (Common Core, PD, grade level meetings, Coaches)

- If so, have you resolved them?
    - If teacher answers YES: How did you resolve them? (i.e., seek out help, went online, talk to math coach?)
    - If teachers answer NO, explore why not?

2. What are some of your concerns regarding student learning at this point in time? (i.e., technology, limited preparation time, assessments)

3. Currently, in which areas would you like more support in? (i.e. talk moves, discourse, 5 practices)

Appendix F

Post-observation Follow-up 3 Exit/Final Interview Protocol

Post-Lesson Observation

1. How do you think the lesson went? (Did anything go not as planned?)

2. Were there any unanticipated moments in your lesson? How did you respond to that (your reasoning and decision making at the moment)

3. What did you learn about your students in this lesson?

4. What are your next steps?

Perceptions

1. How do you think this year went?

- Professionally (growth)
- Personally (growth)

2. What did you find most challenging about math this year?

3. How is your identity reflected in your teaching practices and the choices you make in the classroom? (working with principal, PD facilitator, grade level team)

4. Think back to all the math professional development you had this year—including PLC meetings, math labs, coaches—any PD related to math…which one do you recall as being one that you found to be helpful or have made an impact on you as a math teacher? (Which do you think was most helpful for teachers? Greatest impact)

5. Do you feel your understanding of mathematics has improved this year? Your math practices? (or remained the same) If so, in what ways and what do you consider to be the influencing factor?

6. If you could change anything about the math professional development received this year, what would you change?

- Time, content, assignments?

7. In which areas of your mathematics teaching do you feel you still need continued support in?—would like to improve next year?

8. In hindsight, is there anything you would have done differently this year?

9. Where are you now on the 'math' train? Who is driving the train? Where is your coach in relation to the train? Where are your grade level team members in relation to the train? Where do you think your grade level team would place you on the train?

10. Do you think your grade level team has arrived at the train stop? The school? (in other words do you think that the school or your grade level team was able to meet the internal capacity project goals (math goals) this year?)

11. Which 3 words would you use to describe the group identity of the 5th/kinder team?

Tensions and negotiations

1. What types of tensions have you experienced working with your grade level team this year?—do you feel included in the community?

2. What are some things that you learned regarding how to work well with your grade level team—co-teacher?—mode of participation within grade

3. What types of tensions do you perceive your grade level team members experiencing?

4. In the past month, have you encountered any tensions or issues that came about in the context of mathematics teaching? (Common Core, PD, grade level meetings, Coaches)

- If so, have you resolved them?
    - If teacher answers YES: How did you resolve them? (i.e., seek out help, went online, talk to math coach?)
    - If teachers answer NO, explore why not?