New Elementary School Teachers and Mathematics: An Investigation Through Participation in a Community of Practice

by

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A dissertation submitted to the Graduate Faculty in Urban Education in partial fulfillment of the requirements for the degree of Doctor of Philosophy,

The City University of New York

2008

This manuscript has been read and accepted for the
Graduate Faculty in Urban Education in satisfaction of the
dissertation requirement for the degree of Doctor of Philosophy.

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ABSTRACT

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This dissertation reports on a study that investigated the workings of a community of practice with new elementary school teachers and the teaching of mathematics. According to the National Council for Teachers of Mathematics (NCTM, 1991), not only are teachers expected to impart knowledge, they are also expected to facilitate students' learning. With the passage of the No Child Left Behind Act, states are formulating ways to guarantee that "Highly Qualified" teachers teach all students. To meet this requirement, alternative certification programs such as The New York City Teaching Fellows Program, have been created. With new teachers entering the profession many reforms affect urban schools, such as standardized curriculums and new forms of mentoring. Do these new teachers navigate the teaching of mathematics within the structures of an urban environment? How are these teachers becoming facilitators of students' learning, and what do these teachers see as important in their teaching of mathematics?

A community of practice of three new elementary school teachers was created to investigate these questions and to also give these teachers an opportunity to participate in

discussions about mathematics and mathematics teaching. Data collection in both the teachers' classrooms and of the group meetings as well as informal interviews, participant history surveys, and reflective journals informed this study. Through the lens of communities of practice and identity, the methods for data analysis focused on the teachers' reflections on and practice of mathematics teaching and how the intentionally formed community supported the teachers' development and transformation as mathematics teachers. In analyzing these data, I have specifically looked for patterns and themes that help to recognize these participants as mathematics learners and teachers through the discourse among the researcher and teachers, both in the teachers' mathematics classes and in the group meetings. I am also establishing themes and patterns that bring understanding to the role of the community of practice in the teacher's learning and professional growth.

The findings indicate that the impact of this community of practice on the learning and development of these new elementary school teachers was great. The teachers increased their confidence and competence with mathematics and their willingness and ability to access resources by developing the skills of reflection and inquiry. More importantly, the continual learning of these new teachers is supported by the involvement in a community of practice and support of a mentor.

ACKNOWLEDGEMENTS

I want to acknowledge the three teachers who participated in this study. Without their interest in mathematics and mathematics teaching, this study would not have gotten off the ground. Working with these teachers was a wonderful experience and as I stated throughout the course of the research, "I love the day to day of this research project and working with these teachers."

Thank You Nick Michelli for educating me in educating educators. Your support and friendship throughout my graduate work enabled me to do more than I ever thought I would and think in ways I never thought I could. I wish to thank MetroMath at the City University of New York and Professor Laurel Cooley (the principal investigator) for funding me throughout my last three years of graduate work. Professor Cooley consistently pushed me to get started on my dissertation by pushing me to think of a topic, write my research questions, and get my participants. Thanks also to Professor Frances Curcio for being on my dissertation committee and her continued support throughout the process.

None of this would have been possible without the support from my family. Thank you to my father who always encouraged me to do whatever I wanted to do. Thank you to my mother for setting the example of being a working mother in pursuit of higher degrees. Thank you to Elaine, my stepmother and friend, who never thought she would spend so many hours editing my writing. Thanks to my husband, Pranav for supporting me throughout my years of graduate work especially in the last few months when he began to feel like a single parent. Finally, thanks to my two wonderful children,

Tamrin (born at the end of my second semester) and Kylor (born at the end of my eighth semester) for the smiles, hugs and kisses that made me make it to the end.

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CHAPTER 1

INTRODUCTION

Statement of the Problem

Elementary school teachers are generalists who are responsible for teaching mathematics as well as many other subjects. According to the 2000 National Survey of Science and Mathematics Education by Horizon Research, about 1 percent of elementary school teachers were mathematics majors (Malzahn, 2002). While it is not necessary for elementary school teachers to be mathematics majors, they should at least have ease with the content. Richer content knowledge would yield greater comfort with mathematics, and as a result increase student achievement (Ball, 1990; Darling-Hammond, 1996; McDiarmid and Wilson, 1991). For most elementary school teachers, mathematics is not their main subject strength, although they are responsible for teaching the foundations that will help students develop their own mathematical knowledge. The emphasis on standardized test scores for mathematics has elevated the importance of mathematics education at the elementary school level. Other reasons for the increased importance of mathematics education are the emergence of a global market driven by technology, the recognition of mathematics as a "gatekeeper" to make it through high school and into college (Ladson-Billings, 1995; Moses and Cobb, 2001), and the knowledge that mathematics leads to full participation in society through the acquisition of quality jobs (Nasir and Cobb, 2002; Nasir and Cobb, 2007; Rothstein, 2004). It is not just the increased importance in mathematics, since mathematics has been a part of formal

schooling for a long time, but an increased emphasis on conceptual understanding and mathematical sense-making (Lindquist, 1997). Not only are the teacher's pedagogical knowledge and mathematical content knowledge important, but so is the teacher's mathematics knowledge for teaching (Ball, 2003). Mathematical knowledge for teaching has been defined by Hill, Rowan and Ball (2005), as the knowledge necessary to teach mathematics, for example by explaining concepts, interpreting student work, and working with and adjusting textbook representation of topics. This conclusion is similar to the most recent position of the National Council for Teachers of Mathematics (NCTM, 2008). Earlier, the report on professional standards from NCTM held that teachers should be able to impart knowledge in addition to becoming facilitators of students' learning (NCTM, 1991). Furthermore, teachers must be able to choose appropriate tasks that would then lead to differentiated questioning that challenges all students in the learning of mathematics (NCTM, 2000).

The National Commission on Mathematics and Science Teaching for the 21st Century has reported that schools are in a staffing crisis because of high teacher turnover in "hard-to-staff" schools (Ingersoll, 2000) caused mainly by job dissatisfaction and school staffing actions. Ingersoll (2004) defined school staffing actions to include "departures due to lay-offs, terminations, school closings, involuntary reassignments, and reorganizations" (p. 10). Furthermore, it has been found that there is a 22 percent annual public school teacher turnover in high-needs schools nationally (Ingersoll, 2003). At the city level, there are approximately 8,000 new teachers hired in New York City public schools every year. Of these new teachers, approximately 1500 – 2000 are elementary school teachers who have entered the profession via various certification pathways, be

they traditional or alternative (Betsy Aarons, NYCDOE Director of Human Resources Department, telephone communication, March 25, 2008). High teacher turnover leads to large numbers of new teachers. With many new teachers in the system at the same time, the support systems are spread too thin, leaving the teachers to figure out how best to teach their students on their own. Furthermore, school reforms have had varying effects on elementary school teachers and the teaching of mathematics. Reforms, since 2000, that have had an impact on teachers and the teaching of mathematics include the institution of certification programs, subject-specific mentors such as mathematics coaches, professional development programs, and standardized mathematics curricula.

All of these reforms have had some effect on students learning mathematics. Understanding how teachers work with the policies and reforms in their teaching of mathematics may lead to better supports, education, and retention for the profession. Moreover, a greater understanding of what is important in the teaching of mathematics for new elementary school teachers will help to modify supports necessary in order to improve the teaching of mathematics at the elementary school level. Using identity and community of practice theory, this study will create a description of teacher identity, reflection and practice among the participants.

The use of a community of practice, a construct in which participants engage in collective learning that is supported by the pursuit of common goals and social interactions (Wenger, 1998), is a missing support structure for many new teachers. Further, discomfort that many elementary school teachers have with mathematics may be explained using identity theory. The identity one has works in conjunction with one's practice. The concept of identity is central to the growth of teachers as learners.

According to Wenger (1998), identity is a way of determining who a person is in relation to a learning process and in the context of communities.

In this study, I focused on the identity transformation of three new elementary school teachers as they relate to mathematics and mathematics teaching both in their teaching and within the group of new teachers structured as a community of practice. Furthermore, I describe the structures that influence these teachers' practice in relation to these teachers as mathematics teachers. Understanding how new elementary school teachers navigate the teaching of mathematics given the structures of public schools and mathematics reforms and the benefits or drawbacks of a community of practice will further inform the education of new teachers. Most important, this study sheds light on the following questions: Do new elementary school teachers navigate the teaching of conceptually challenging mathematics given the structures of public schools, mathematics reforms, and their level of preparation of pedagogical and mathematical content knowledge? Furthermore, given the known difficulties involved in beginning a teaching career, can a community of practice/inquiry help to establish more positive identities for elementary mathematics teachers?

Research Questions for This Study

Through the involvement in an intentionally created community of practice of new elementary school teachers and through the informal mentorship provided by the researcher in the teachers' classrooms, the participants in this study experienced a change in both their teaching of mathematics and their own identities as mathematics teachers. In this study, I examine the changes in the identity of these elementary school teachers as well as the ways in which this group of participants began to bring together the many

influences on their practice of teaching mathematics. I explored their use of resources in the teaching of mathematics and the structures that defined their teaching leading to an identity transformation. Mathematics and mathematics teaching were central to the discussions that occurred during the community of practice/inquiry. Furthermore, what was found to be essential in the teaching of mathematics played an important part in how the teachers viewed their mathematics teaching and mathematics as a whole. The purpose of this study was to gather descriptive information about the experiences and preparedness of these new elementary school teachers in the teaching of mathematics while working with the policies and reforms of an urban school environment. This readiness to teach is based on the teachers' views of themselves and discussions with the researcher. An organized community of practice for the participants was formed to gather these data as well as to serve as a venue for guidance and support in their teaching of mathematics.

The current policies affecting the teaching of mathematics in urban schools, the identity of elementary school teachers as mathematics teachers, and the use of the resources available to teachers as they begin teaching led to the formulation of the following research questions:

1. Do new elementary school teachers navigate the teaching of conceptually challenging mathematics within the structures of urban schools? And if so, which resources do they access and how do they use them?
2. How do participants identify themselves as "teachers of mathematics"? Do their ways of identifying themselves change over time as they become involved in a community of practice/inquiry? If so, in what way(s)?

3. Does the researcher's participation in a community of practice/inquiry transform her identity of teaching mathematics in an urban school environment? If so, in what way(s)?
4. Do these new elementary school teachers provide opportunities for their students to engage in conceptually challenging mathematics? If not, what are the obstacles?
5. Does the path taken to teaching elementary school mathematics affect these teachers' identities as mathematics teachers, their preparedness to teach mathematics, or their manner of accessing and using resources and, if so, how?

Definitions

A large part of this study was based on the use of a community of practice in which three new teachers participate. Communities of practice are informal groups in which participants learn from the events that unfold in the environment in which they are situated (Wenger, 1998). Wenger (1998) describes the learning that emerges within a community of practice as the collective learning which is supported by the pursuit of common goals and social interactions. Lave and Wenger (2003) define a community of practice as a set of relations among participants, activity, and the environment. Wenger makes the point that "practice is not inherently unreflective" (p. 48), but to incorporate more fully the idea of reflection through discussion, community of inquiry as defined by Lipman (1988) is used to explain further the experiences of the group meetings. A community of inquiry has the characteristics of being "perspectival, social and communal" (p. 148).

To understand further a community of practice, one must look at the participants involved in the community. The identity transformation of the participants is central to

gaining a description of the community of practice. A person's identity can be expressed in relation to himself/herself, in relation to the environment, and in relation to others. The concept of identity as a dynamic force is central to the growth of teachers as learners. This conceptualization of identity is supported by Wenger (1998), who cites identity as a means of discussing how learning changes who we are in relation to the communities in which we are situated. Furthermore, Gee (2000-2001), who defines identity as how we are perceived by others in society and through our performance in society, divides identity into four categories: nature identity, institution identity, discourse identity, and affinity identity. Though all of these categories are connected to Wenger's definition of identity, affinity is the category based on being part of a group.

It is important to examine how these teachers navigate through their practice as teachers of mathematics in relation to their learning trajectory and their identity transformation. The term "navigate" is used to describe how the participants find a way to reach their goals and is used as a means to convey the difficulty of teaching mathematics. Navigating through the structures of urban schools may be a challenge and as a result involves the knowledge of agendas and approaches that are at play within the context of urban education. Knowledge and a greater awareness of these various structures in terms of the specific environment in which one is living or working gives one the ability to "transpose or extend" or have agency (Sewell, 1992).

A teacher's agency is his or her interactions with resources within an environment and the practice that occurs as a result of these interactions (Tobin, 2005). It is the power to act or the ability to take action to reach one's goals. For a mathematics teacher, being able to access resources and make use of them is an important aspect of agency. In the

context of new teachers, how and whether these teachers use the resources available to them to teach mathematics effectively affects their ability to teach conceptually challenging material and their identity as mathematics teachers. For example, a teacher who uses the opportunity of a student's question to further the mathematical investigation appropriates a resource to reach a goal.

As the participants were involved in the community of practice, their teaching, mathematics as a subject, and outside influences on their teaching were topics of discussion. The foundation for much of this discussion was the idea of conceptually challenging mathematics (CCM). MetroMath[1] at the City University of New York has defined CCM to mean mathematical activity that emphasizes reasoning, explanation, and investigation, in which making connections and understanding are part of the learning process. A teacher should encourage her or his students to engage in the practices of reasoning, explaining, and investigating, giving them opportunities to demonstrate their thinking through questioning and making connections to students' prior knowledge (Cooley, Angulo, Donoghue, Meagher, and Michelli, minutes of MetroMath meeting, 2006). This idea of conceptually challenging mathematics is similar to ideas presented in the National Council for Teachers of Mathematics Standards (NCTM, 2000), in which it was argued that mathematics should be taught for deep understanding through the investigation of mathematical concepts and problem solving.

Finally, what do I mean by a "teacher of mathematics"? My definition is similar to how Luehmann (2007) defines her "teacher professional identity": A teacher of

[1] MetroMath is a National Science Foundation funded center for learning and teaching mathematics. The two purposes are directed at improving the mathematics education in urban areas through research and the development of leadership in urban mathematics education. http://www.metromath.org/

mathematics is recognized as such through his/her discourse regarding mathematics teaching and his/her practice of mathematics teaching. This discourse and practice reinforces the fact that content helps one to become fluent in the language of mathematics and the practice of mathematics teaching but it is not the only influence on practice. A teacher of mathematics should demonstrate in his/her practice of mathematics the mathematical knowledge for teaching. The mathematical knowledge for teaching is defined as the knowledge necessary to have the ability to adjust one's teaching of mathematics based on the experiences in the classroom and with one's students (Ball, 2003).

Why Is This Subject of Interest To Me?

My interest in elementary school teachers and mathematics grew out of my extensive involvement in all levels of mathematics teaching. I began my teaching career immediately after graduating from college with a degree in pure mathematics, without having taken any education courses. I pursued mathematics initially because I liked it and I was a successful mathematics student. As a student progressing through the traditional mathematics curriculum up to calculus, I began to be challenged by the material. However, it wasn't until college-level mathematics that mathematics became more about problem solving and less involved with rote memorization. At first I struggled, but with the help of some of my college professors, I began to look at mathematics as a puzzle to be solved with many different possible solutions. My interest and enthusiasm for mathematics led me to pursue teaching. I taught a range of mathematics levels to students in private schools in grades 3 – 12 for eleven years, and I

developed a deep understanding of the stages of students' learning of mathematics and the progression of a mathematics education curriculum. I give credit for the large body of pedagogical and curricular knowledge I acquired to the community of mathematics teachers in my schools. I tended to deviate from the pedagogy of teachers who were very traditional in their teaching styles because their methods did not seem to fit with my philosophy of learning and teaching mathematics. Traditional teaching was very teacher-centered, with the teacher presenting a technique followed by students practicing problems from a worksheet or textbook. I believe that mathematics is fun and that the best way to learn it is by discovery, exploration, and problem solving, all with a deep connection to understanding mathematical concepts. My teaching style evolved from teacher-centered to student-centered as I became more experienced. I gathered my knowledge of mathematics pedagogy on the job, and I recall my first year of teaching to be a trial.

Similar to teachers in many studies (Ball and Wilson, 1990; Warfield, Wood, and Lehman, 2005; Wilson and Ball, 1991), which state that teachers tend to teach the way they were taught in secondary school, I learned much about teaching from my own experience as a student. I began teaching mathematics as a nervous first-year teacher with strong mathematical content knowledge who did not deviate from what the text stated. I learned high school mathematics by learning a formula or technique and plugging in the necessary values to solve a problem. However, as I continued teaching, I began to use other resources available to me, including my peers, the students, textbooks, and my own learning experiences from college to create mathematics lessons that focused on deepening my students' mathematical understanding. This experience with

collaboration fueled my interest in building supportive communities for other novice mathematics teachers; communities where they learn to reflect on their teaching and teach for mathematical understanding.

My continued reflection on students' learning furthered the development of my identity as a mathematics teacher. I wanted my students to be able to make the deep connections in mathematics necessary for a strong foundation, as did several of my colleagues. Soon, a group of mathematics teachers, of which I was fortunate to be a member, was formed in order to structure the curriculum around projects that enhanced conceptual understanding. Given that elementary school teachers teach not only mathematics but other subjects as well, it became apparent that we, the mathematics teachers, approached mathematics and the teaching of mathematics in different ways. I tended to look at the ideas behind the mathematics topics in the context of what mathematics concepts will be important in the future and the fundamental ideas behind a topic, while many of the other elementary school teachers focused more on the procedure or technique at hand. My experiences and my own personal desire to improve mathematics education led me to create this community of elementary school teachers.

Theoretical Framework

These previously defined terms lead us to look deeper into the theory that frames this research: community of practice theory, identity theory, and learning theory. The communities of practice as described by Lave and Wenger (2003) form the basis for this study. A teacher enters a school community as a newcomer who experiences relationships with the "old-timers," the history, the environment, the tools, and the

identities of people within the community. This relationship enables the newcomer to appropriate the knowledge of the community. Teachers learn the practice of teaching mathematics in their classrooms while simultaneously learning the culture of the school through their experiences in the community and interactions with their colleagues. I found communities of practice theory to be a very useful tool for looking at new teachers and teaching, especially in relation to identity transformation. Community of practice theory also coincided with my own experiences in teaching in that when I was a new teacher I learned from other teachers in the mathematics department.

The apprenticeship model expressed in Lave and Wenger's (2003) work makes the important distinction between first observing on the periphery and then learning a skill and developing mastery through practice. The initial period of teaching, or any learning experience, can define one's practice. Historically, new teachers were expected to "sink or swim" (Lortie, 1975). With this model, many teachers reverted to a teaching method that is familiar to them and did not deviate, reflect on, or change their method (Feiman-Nemser, 2001). For elementary school teachers, mathematics teaching is only part of their day; as a result, a new teacher may not identify with the characteristics of a mathematics teacher who teaches conceptually challenging mathematics. The goal of many preservice or in-service education programs is to develop skills that will lead to ongoing study and reflection about teaching. Communities of practice can give teachers the opportunity to continue their study of and reflection on their own teaching.

Cultural historical activity theory (CHAT) informs the use of communities of practice as a theoretical framework. CHAT is basically the attempt or practice of a subject to reach his/her goals (object) with the influences of tools, rules, community, and

division of labor (Engeström, 1987; Engeström and Cole, 1995; Vygotsky, 1978). While being involved in a community of practice, the participants use the tools that are part of the community to reach their goals. In addition, how a subject infuses tools with new meanings or adapts tools for new uses is a way of transforming his/her practice and a way of creating new knowledge. The cultural aspect of this system determines how the structures the participants are involved in affect their practices.

Identity theory involves who we believe ourselves to be and who we are in relation to others. A number of scholars have used the term "identity" to help explain teacher development and learning (Enyedy, Goldberg, and Welsh, 2006; Gee, 2000-2001; Lave and Wenger, 2003; Sfard and Prusk, 2005; Tobin and Roth, 2007; and Wenger, 1998). These scholars' ideas about identity interconnect. I used identity theory to help to understand the identity transformation of the teachers I worked with into "teachers of mathematics." Based on the work of these scholars, I would characterize the work of identity as follows:

- Identity is dynamic.
- Identity is socially constructed – a cultural study of the person in practice.
- Identity is also internally constructed – but in relation to others.
- Identity is influenced by one's actions – experience becomes meaning.

Others have placed the concept of identity as being informed by issues of power (Holland, Lachiotte, Skinner, and Cain 1998; Roth, 2006b). In the context of this study, the new teachers are not able to practice with as much autonomy as veteran teachers. In relation to the participants' identity, this constriction comes into play in how they view themselves. Bullough (1989) explains how "the first-year teacher, upon first walking

through the school's doors, enters more than a building. As a complex, active bearer of habits, values, and beliefs – as a unique person – he or she enters a set of established roles, relationships, ways of behaving, and understandings […] that give a particular school its unique character. For the most part these are taken for granted, and principals, parents, students and other teachers urge conformity" (p. 5). During a period that Bullough refers to as the survival stage from Kevin Ryan's stages[2], Kerri, a first-year teacher was "teaching someone else's program"; she stated that she did not feel like a teacher. "I am not in on any of the planning. It's not personal for me, this unit, it's totally impersonal" (p. 99). This led Kerri to feel disconnected and disengaged, which went against her internally constructed identity, and as a result she began to become involved in in-service programs offered by her district.

Initially, learning theories can be regarded as how people learn in practice. Looking at the work of Vygotsky (1978) and Dewey (1997), what people do in practice influences how people learn. If the practice is designed to further our learning, then it involves "overcoming the inertia that inclines us to accept suggestions at their face value" (Dewey, 1997, p. 13). To be put in a situation of reflective thought leads to uncertainty and then further inquiry. Although Vygotsky writes about the development of the child's mind in *Mind in Society* (1978), these ideas can be applied to look at how we think and how we learn in social situations. Vygotsky writes about how social interactions are central to how we learn, reflect, and change.

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[2] Bullough (1989) refers to Kevin Ryan's stages when reporting on Kerri's first year of teaching. These stages are described as a "fantasy" stage, a "survival" stage, a "mastery" stage and finally an "impact" stage. Ryan argues that a teacher must make their way through these stages on the way to professional competence. Many new teachers begin at the fantasy stage and soon move on to the survival stage. The mastery stage comes when a new teacher begins to learn the "craft" of teaching.

Situations in which participants can talk together, work together, generate ideas, build on others' ideas, reason, explore, and discover together are reflective learning environments. Teachers who are aware of this and are involved in this practice have the ability to become what Franke, Carpenter, Fennema, Ansell, and Behrend (1998) call "self-sustaining generative" learners. This process incorporates not only reflecting on the practice of teaching but also continuing to engage in practice that is supported institutionally so that there is constant change and growth. Furthermore, reflection leads to connecting mathematics to the teacher and then to the student, which is essential to learning the material (Dewey, 1990; Saxe, 2002; Vygotsky, 1978). These arenas for reflection among teachers coincide with the skills they should have in their teaching. "Teachers learn best by studying, doing and reflecting, by collaborating with other teachers, by looking closely at students and their work and by sharing what they see" (Darling-Hammond, 1998, p. 1). Moreover, having strength and comfort in mathematics and mathematics knowledge for teaching is essential for teachers if they are to have the ability to modify their teaching, instruction, and assessments and to make sound judgments (Ball, 2003). Through an investigation of various types of knowledge that teachers benefit from when they teach mathematics, Ball concluded that teachers' content preparation should be grounded in practice (Ball, 2000). And finally, Warfield, et al. (2005) believe that in order for students to become more effective mathematics learners, they must become more self-directed and reflective.

This theoretical framework and the context of the study are discussed in the next chapter. The community of practice of new elementary school teachers and their individual experiences outside the formal community were examined.

CHAPTER 2

A REVIEW OF THE LITERATURE

Communities of practice, identity transformation, and theories of knowledge acquisition are the foundation for understanding this study and will be discussed in the first part of this chapter. The inspiration of this study came from diverse personal experiences: being a teacher and working with other teachers who taught mathematics in private schools; being a researcher/observer of new secondary school teachers in the New York City public schools; being an intern at the New York City Department of Education (NYCDoE) while extensive professional development was being implemented to support the new standardized curriculum of *Everyday Mathematics*[3] and the use of math coaches; and finally, being exposed to concepts in current areas of research in mathematics education, elementary school education, professional development, teacher knowledge, mentoring, and identity.

This chapter will conclude with an overview of the many policies that are affecting new elementary school teachers in the New York City public schools in relation to the teaching of mathematics. The policies that have some direct influence on this study are teacher education and qualification, teacher certification, standardized curriculum and assessment, and mentoring and professional development. These policies have a varying effect on teachers, and it is important to refer to them in order to understand the participants in the study and appreciate the importance to this research.

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[3] *Everyday Mathematics* is a comprehensive pre-kindergarten through 6th grade mathematics curriculum developed by the University of Chicago School Mathematics Project (UCSMP), and published by Wright Group/McGraw-Hill. The edition used during this study was published in 2004.

Communities of Practice

Using community of practice theory to study teacher learning and identity is a way to "open up our practices and communities to others (Wenger, 1998, p. 277). In bringing a community of practice to new educators, this study creates an opportunity for learning and identity transformation. Lave and Wenger (2003) refer to a community of practice in relation to the concept of situated learning in legitimate peripheral participation. Their theoretical framework has as its premise the fact that "learning occurs as people engage in activities of a community" (p. 22). Much of Lave and Wenger's theory is based on the idea of a learner entering the periphery of a community and learning first at this level. Often this learning occurs through observation. Gradually the learner begins to participate in the activity of learning the specific practice of the community, so peripheral participation occurs. This learning continues until the learner begins to take on a greater role in participation and activity. The learner now becomes a master in the practice and therefore a full-fledged member of the community of practice. Through this transition from observer to peripheral participation to master, the learner develops "an increasing sense of identity as a master practitioner" (Lave and Wenger, 2003, p. 111).

While Lave and Wenger's joint work emphasizes individual learning, Wenger (1998) also studies the collective learning of participants in a community. He defines a community of practice as a "community of mutual engagement, a negotiated enterprise, and a repertoire of negotiable resources accumulated over time" (p. 126). This theory is reflected in the experience of new teachers. As a teacher enters a school community, he or she takes on the role of a newcomer who experiences relationships with the "old-

timers," the events, the environment, the tools, and the other identities within the community. The learning of new teachers is often processed in the form of individual learning. However, even considering the individual nature of learning, many new teachers learn about the community through experiences with others in the profession. In this comparison, the community of mutual engagement consists of the teachers who are members of the school community, the negotiated enterprise is the appropriation by the new teachers of the knowledge of the community, and finally, the accumulation of resources occurs through interaction between new teachers and their colleagues in the school.

Though communities of practice are usually informal and undefined entities (Wenger, 1998), an intentional community of practice can bring together the reflective learning aspect that Lipman (1988) described in his communities of inquiry. A community of inquiry is one in which participants can talk together, work together, appropriate ideas together, build on one or others' ideas, reason, explore, and discover together. Lipman stated that in creating learning environments that are communities of inquiry, one needs to move away from the "information – acquisition" (p. 19) model and move toward "self-corrective exploration of issues that are felt to be both important and problematic" (p. 20). In all communities of practice and inquiry there is an initial hierarchy. In the situation presented in Lave and Wenger's work (2003), there is an apprenticeship model in which the newcomers learn from more experienced participants. Lipman (1988) also supports the need for there to be a member of the community of inquiry who frames the inquiry, structures the dialogue, and mediates for the other members of the community in resolving doubts and uncertainties. While this structure

may be considered a hindrance in certain communities of practice because a power dynamic works against the learning of the participants, it may also be an asset for other types of communities of practice because of the need for a participant who is a mediator and possibly a source of knowledge.

Teachers who are aware of the necessity for reflection and inquiry discussed by Lipman can experience what Franke, Carpenter, Fennema, Ansell, and Behrend, (1998) refer to as "self-sustaining generative change." This reflection and change in the teachers' learning occurs in practice either in the classroom or with a group of fellow teachers (Wood, Cobb, and Yackel, 1991). Rather than functioning in isolation on their own, this view of teacher development and learning puts the responsibility on the teachers to learn in a social environment. Mathematical learning involves both the personal construction of meaning and the negotiation of the taken-as shared meaning of the community (Cobb, 1994). Furthermore, this reflection leads to connecting mathematics to the teacher and then to the student, which is important to the learning of the material (Dewey, 1990; Saxe, 2002; Vygotsky, 1978). These arenas for reflection among teachers coincide with the skills they should have in their teaching. "Teachers learn best by studying, doing and reflecting, by collaborating with other teachers, by looking closely at students and their work and by sharing what they see" (Darling-Hammond, 1998, p. 1).

Communities of practice have been used in the research of learners on many levels. Following the learner from the periphery to participation to mastery is a way to describe the trajectory of development for members of a community. Darling (2001), in her research on new elementary school preservice teachers, found that in order for these

teachers to learn, the members of the community of inquiry needed to be committed to "ongoing research, critical reflection, and constructive engagement with others" (p. 8). Darling builds on the work of Bereiter and Scardamalia (1993), in which they refer to a community of learners as a group that is created to encourage activity for sharing knowledge and supporting one another in knowledge creation. Similar to Lipman (1988), Darling (2001) recognizes that for a participant to reach a conclusion or experience some change, the participant needs to be involved in problem solving that will lead the participant to experience some doubt, and therefore, need to come to some resolution.

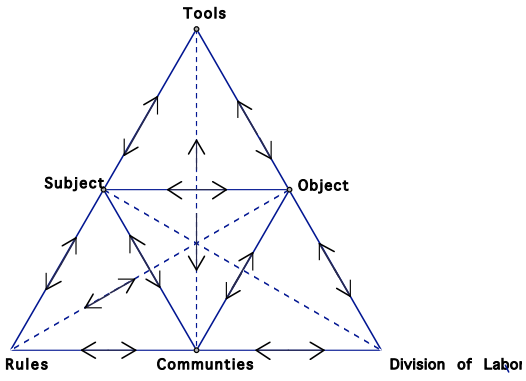
It is important for a community of practice to look at the idea of a "shared vision" (Senge, 1990, p. 10) or a common goal. Not only does each member of a community of practice need to have a vision of what he or she wants from being involved in the community of practice, but also the members should come together as a group and create a shared vision. "A vision is truly shared when you and I have a similar picture and are committed to one another having it, not just to each of us, individually, having it" (Senge, 1990, p. 206). In a community of practice, the individuals or learners involved in the practice work together to move through participation and then mastery. Community of practice theory is used widely in educational research and Wenger (1998) makes it clear that communities of practice cover many fields. Senge (1990), a writer on management theories, uses a similar theory when discussing what he calls a "Shared Vision." When proposing the idea of a shared vision in "learning organizations" (another way of thinking about learning communities), Senge points out that this common goal is important because it provides the direction and drive for continual learning. The final outcome of a community of practice is that the participants take what they learn and create new

communities of practice where the process repeats itself. Darling (2001) similarly states that in order for a community of inquiry to be successful, the community needs to be clear on its goals and be committed to the deliberations necessary for inquiry and continuous learning.

Cultural Historical Activity Theory (CHAT)

Several structures, tools, people, and experiences may influence teachers in creating their practices. In this community, activities occur. How these activities play out among the individuals and the group can be theorized with the help of Cultural Historical Activity Theory (CHAT), as synthesized by Engeström (1987, 1999) from the works of Vygotsky and Leont'ev. CHAT can be explained by looking at an individual who is the subject of an activity. This subject has goals. These goals (the object) are reached by activity that is influenced through the use of tools, a set of rules, a community, and division of labor in the field in which the activity occurs (Engeström, 1987; Engeström and Cole, 1995; Vygotsky, 1978,). The influences on a system work against one another. For example, who the subject is or identifies with is influenced by the community for which the activity takes place. Also, the rules of the system (i.e., community) may precipitate the object (i.e., the goal) of the activity. The triangle model represented below (Figure 1) is a pictorial representation of CHAT, as created by Engeström (1987):

Figure 1:



Looking at the triangle model, CHAT can be further explained as a system of activity or a relationship in which a subject (i.e., the teacher) and an object (i.e., the teaching of mathematics to students) is working toward some larger goal through the use of tools, and the influences of rules, the communities, and the division of labor. When analyzing such an activity system, one looks for contradictions and patterns. An active use of tools builds a deep understanding of the world in which the tools are used and of the tools themselves (Brown, Collins, and Duguid, 1989). These tools can include a teacher's discourse in mathematics, the curriculum, the textbook, and the mentors, as well as other tools. How teachers appropriate these resources to have agency (i.e., the ability to take action) in reaching their goals, is a significant part of what occurs in the community of practice/inquiry.

In relating CHAT theory to a community of practice, the participants use tools that are part of the community to reach their goals, the object. In this study a community of practice was created as a way for the participants to improve their mathematics teaching and understanding. The tools used during the community of practice for the study, or what became informally known as "the group meetings," were videos of classroom observations, mathematics problem solving, the curriculum used for teaching, and the other members of the group. The activities that took place were mathematical thinking, reflection on teaching, an exchange of ideas, and other discussions of topics of interest. How a subject infuses tools with new meanings or adapts tools for uses not necessarily intended is a way of transforming one's practice and creating new knowledge.

In addition to the use of tools, it is important to recognize CHAT's connection to community of practice theory in relation to the reaching of one's goals. The activity

system is constantly working on itself, which is similar to how Dewey (1997/1910) sees a successful community of people. They need not only to communicate their goals but also, working together, they need to revise them and reach them. "To have the same ideas about things which others have, to be like-minded with them and thus to be really members of a social group, is therefore to attach the same meanings to things and to acts which others attach" (Dewey, 1997, p. 29). Dewey's concept is similar to Senge's (1990) view of learning organizations; in order for there to be a common goal or direction and the drive for change or continual learning, there needs to be a "Shared Vision."

Identity Theory

There are other aspects of the practice of teaching that are influenced by and that influence the community of practice. One's practice is not only dependent on one's activity but also on who one is. According to Roth (2006a), identity depends on who we believe ourselves to be and who we are in relation to others. Gee (2000-2001) goes further in explaining a theory of identity in which an individual's identity consists of four categories; it is a useful theory for research in education. The four categories for viewing identity as described by Gee are Nature-identity (a state), Institution-identity (a position), Discourse-identity (an individual trait), and Affinity-identity (experiences). Gee (2000-2001) states that these four categories should not be viewed separately in theory or in practice. The Gee identity categories that can most closely be connected to Wenger's work with communities of practice and identity are Affinity identity and Discourse identity. Gee's idea that "[A]n affinity group is something that one must actively choose to join" (p. 106) is consistent with participants being involved in an intentionally created

community of practice. One's identity depends on one's experiences within the group. Gee describes Discourse identity as relating to one's recognition through the use of a commonality of terms, while in Wenger's communities of practice, a participant also becomes part of the group or can be identified as part of the group based on the participant's discourse. Wenger (1998) suggests that an identity can be described as a "way of talking about how learning changes who we are and creates personal histories of becoming in the context of our communities" (p. 271). Similar to Roth (2006a), Gee (2000-2001) sees identity as one's performances in society or one's practice in relation to others.

Others relate identity to the story or "narrative of a person" (Holland, et al., 1998). While the story is an important component to one's identity, one's story changes because of one's identity and because of the context of the story, and one's identity changes because of one's specific stories. For example, a woman may have a story that is associated with her rise in a law firm and this story is connected to her identity as a lawyer, but she has a very different story when talking about her family and her identity as a mother. These stories or "narratives" connect to Gee's Affinity identity and Roth's view that identity is ever changing or transformative.

Looking at identity in relation to a mathematics teacher's identity, one can make a connection between the practice of a mathematics teacher and the theory of identity as originally introduced by Wenger. Van Zoest and Bohl (2005) have defined a mathematics teacher's identity in relation to a teacher's beliefs and knowledge about what teachers actually practice in the classroom. The creation of a "mathematics teacher identity" was developed to help link teachers' prior knowledge, learning, and the

transformation that may occur to their relationships in their communities. In recognizing that identity depends on one's "sense of self" and one's "habits of mind," Spillane (2000) defined identity as "an individual's way of understanding and being in the world, in this case the world of work" (p. 308). He further contends that a teacher's identity depends on the subject-context that he or she is teaching. For elementary school teachers, the subject matter context is a factor in how these teachers negotiate their ability to learn and therefore teach the subject.

In connecting CHAT with one's transforming identity, the tools of an activity system enable the subjects to reach their goal of becoming mathematics teachers. Therefore, as the subjects acquire the resources to develop into teachers of mathematics, they continually change their identity (Sewell, 1992). Being involved in an activity system motivates the subject to take on an identity that is affected by being involved in ongoing activity (Roth, Tobin, Elmesky, Carambo, McKnight, and Beers, 2004). One's identity is a dynamic phenomenon that is affected by environment, culture, and actions. Identity is ever changing in relation to the community in which one is situated or the experience one is having. Wenger's (1998) concept of identity is directly connected to whom a person is in relation to a context of communities and the "personal histories" that are created in those communities. The concept that identity is ever changing is an important one. Teachers may have a specific identity in their classroom that may change due to interactions in other communities of practice outside of the classroom. Identity can be expressed in relation to oneself, in relation to the environment, and in relation to others. The concept of identity as dynamic is central to the growth of teachers as

learners. One's experience needs reflection and the discourse of a community of inquiry to meld into "the constant and continuous aspects of identity" (Roth, 2006a, p. 152).

Many teachers form their identity in relation to the subject they are teaching, while others base it on the relationships with the students in the context of the school, how they work with students, for example, collaboratively (Proweller and Mitchener, 2004). This is similar to Sewell's (1992) idea that one's history gets reconstructed as social or cultural capital and becomes the structure that leads to one's agency. Social capital is the network and resources that an individual uses to navigate in the domain in which he or she is situated. The term "cultural capital" specifically refers to an individual's personal qualities in relation to her or his background (Bourdieu, 1984). Within the context of teachers, a background that is defined by being a successful mathematics student may lead to teaching mathematics the way one was taught because that approach was successful.

According to Lave and Wenger (2003), knowledge results from a combination of the interaction of people, activities, and goals in a particular situation. Thus, creating an environment where teachers can discuss how they could or would teach fractions using specific manipulatives is an example of the structures influencing agency. In the teaching of mathematics, the social constructivist theory of learning stresses the importance of learning through communities of learning or practice (Berk and Winsler, 1995). In order for teachers to teach mathematics in an environment in which mathematical discourse is supported, they themselves should participate in such a discourse in a community of practice. Boaler and Greeno (2000) suggest that students' learning of mathematics follows a "trajectory of participation" (p. 172). Similarly, teachers of mathematics learn

mathematics through both discourse and thinking in a community or "social practice." One could suggest that learning to teach mathematics may take place in such a community of practice. Because teaching is dynamic, teachers need to find ways to be continual learners. Being a continual learner affects one's identity since one's identity will change to that of a "decision-maker" in the process of teaching mathematics (Warfield et al., 2005).

Studies have been conducted that investigate a teacher's beliefs and his or her changing identity. In an alternative certification program in southern California in which content and methods were integrated into the education courses, Hart (2004) found over the course of the first year of teaching that the new teachers believed firmly in constructivist teaching methods but found it frustrating to go against the norms of the schools in which they worked. Furthermore, the confidence they expressed in their own knowledge of mathematics was still weak. Proweller and Mitchener's study of alternatively certified science teachers (2004) found that empowering the teachers as inquirers produced a scientific knowledge base in which greater learning possibilities were available to the urban students. Brett, Woodruff, and Nason (1997) found through the course of his study that preservice teachers' identities changed. They identified themselves as mathematicians not necessarily because of increased mathematical knowledge, but because they were able to discuss mathematical ideas within a community (p. 26). Finally, there is a great deal of research of the process by which teachers use their students' thinking in order to make themselves continual learners (Franke et al., 1998; Vacc and Bright, 1999; Warfield et al., 2005).

The issue of teacher identity in general naturally raises the question of how teachers, particularly elementary school teachers, create their identities as mathematics teachers. The conceptualization of a mathematics teacher's identity may ideally be based on the best practices for teaching mathematics, and there are suggestions as to what the best practices for mathematics teachers could be. According to Ball (2003), teachers should have mathematical fluency and knowledge of specific fundamental topics – number sense, place value, operations, algorithms and why they work, concepts of algebra, geometric concepts, and concepts in statistics and probability – and all of these should be communicated through the use of representations, language, definitions, reasoning justification, and interest (p. 7). Furthermore, teachers should have opportunities to revisit and expound on their own mathematical ideas and the role of the teacher in order to become good mathematics teachers (Ball and Wilson, 1990). The National Council for Teachers of Mathematics (NCTM) similarly states that teachers should be able to impart knowledge in addition to being able to choose appropriate tasks to challenge all students in the learning of mathematics (NCTM, 2000). This statement supports Van Zoest and Bohl (2005), who argue that teachers need to be able to support the learning of mathematics in the classroom by "drawing upon a much broader range of knowledge and experiences than from learning mathematics itself" (p. 318). Finally, it is important to note that, given the previously mentioned ideas of identity, how each person conceptualizes the characteristics of a mathematics teacher is crucial to the transformation of the identity of a teacher of mathematics over time and within specific situations.

Learning Theories

As stated in the previous section, one's identity plays an important part in one's knowledge of mathematics and vice versa. Identity, mathematics knowledge, mathematics learning, and agency are all connected when discussing a teacher's learning. Boaler and Greeno (2000) argue that how a teacher learns mathematics influences the choices made in his or her work. Luehmann (2007) states that a beginning teacher needs to create a professional identity to support his or her learning. This can occur through being part of a community of practice that supports opportunities to develop "teaching competencies" (p. 824). Not only do professional identities but also learning communities need to be created. "Placing the study of teacher development in a community of practice framework implies that motivation to learn is tightly tied to teachers' views of themselves as aspiring members of a reform mathematics community" (Stein, Silver, and Smith, 1998, p. 38). New teachers need a supportive and comfortable context to be introduced to possible conflict that will lead to a change in their professional identities and therefore their learning.

Van Zoest and Bohl (2005) stress the importance of the difference between learning mathematics and learning how to teach mathematics. They believe that "teaching mathematics requires drawing upon a much broader range of knowledge and experiences than does learning mathematics itself" (p. 318). They argue that the current configuration for the communities in which a teacher develops his or her learning is disconnected. The future teacher starts as a student at a university and then becomes a student-teacher and finally moves on to become a teacher without much overlap between the communities.

Within the current context of teaching, there may be some overlap between the "university community" and the "teaching community," but there is no real "intern community" (p. 327). This situation is the result of alternative certification programs, where teachers begin teaching without much student teaching; they are students at a university at the same time as they are in the classroom teaching. Van Zoest and Bohl (2005) propose a reconfiguration of the communities to improve the development of teachers in their learning of mathematics, most specifically reform mathematics. This reconfiguration of the communities would have greater overlap, a proposal that is similar to the way Wenger (1998) envisions communities. The connection between the communities would come about through joint participation and sharing resources. The most important aspect of this model is a greater overlap between the participation of a teacher in the school community and a teacher in what the authors call the mathematics education professional community. This community originally consists of the classroom community, the school community, and the professional development community. In the Van Zoest and Bohl – conceived model (2005), this professional community encompasses much of the university teacher education community as well.

Teachers' Pedagogical Knowledge and Mathematical Knowledge

What do teachers need to know to be successful teachers of mathematics? Research has shown that both strong content knowledge and strong pedagogical content knowledge are important for teaching mathematics. Teachers also need to be skillful at connecting students' learning to the students' lives (Darling-Hammond, 1998; Villegas and Lucas, 2002). In order to make connections to students' learning, teachers need to be

able to access different strategies and work with various tools (Darling-Hammond, 1998). Another key component in learning to teach is the ability to reflect. There is a great deal of research showing that teachers who reflect and communicate about their students' mathematical thinking learn to teach more effectively (Carpenter, Fennema, and Franke, 1996; Cobb, 1994; Franke et al., 1998; Graeber, 1999; Warfield et al., 2005). These findings are consistent with the view that mathematical knowledge is less an individual practice and more a community practice. This socio-cultural perspective suggests that mathematical knowledge is both socially constructed and individually constructed (Stein, et al., 1998).

Teacher learning has to occur on a continuum from preservice, which can be formal or informal, to new teacher induction, and on to continuing professional development. This continuum can be supported by an "inquiry stance" of one's teaching practice (Cochran-Smith, 2005), where different levels of learning may occur at the same time. For example, in an alternative certification program, teachers may develop the tools to study teaching and learning, while creating a professional identity that helps them expand their skills in the study and improvement of their teaching (Feiman-Nemser, 2001). How to develop strong teacher knowledge is not just a mathematics problem. The National Commission on Teaching and America's Future (2005) reviewed induction programs and found that the United States lags behind many other countries in creating learning communities for new teachers. This Commission suggests that beginning teachers become part of "a teaching community and school culture that supports the continual professional growth of all teachers" (Fulton, Yoon, and Lee. August 2005).

Teaching mathematics requires justifying, explaining, defining, generalizing, and analyzing errors (Ball, 2003). These are many of the same skills that the NCTM's Principles and Standards for School Mathematics (2000) advocates as skills that students should learn in relation to mathematics. According to the NCTM (2000), students should be able to think creatively and flexibly about mathematical concepts and solve mathematical problems with understanding. The hope is that, through this understanding, they will develop independence in their mathematical thinking and will not need to memorize methods for solving specific problems. This approach is consistent with Stein, et al., (1996), who state that to know and understand mathematics is to understand the activities and practices of mathematical thinking and learning and not just to know how to work with the concepts and techniques of the material.

In order to teach mathematics, one needs to have strong mathematical content knowledge (Ball, 2003; Ball and Wilson, 1990; Ensor, 2001; Graeber, 1999). This is a requirement not just for teaching mathematics; elementary school teachers need to have a strong knowledge base not only in the content but also in the ways of questioning and exploring any discipline that is "preferably part of the elementary school curriculum" (Grossman, Schoenfeld, and Lee, 2005, p. 230). Many argue that, in conjunction with knowledge of the subject, there needs to be a deeper understanding of the skills for teaching mathematics, as this would enable the use of resources such as textbooks, which also need to be improved (Askey, 1999). According to Hart (2004), it is unfortunate that the mathematics education part of the methods course is only a small part of elementary school teachers' academic requirements, though recently universities have increased their mathematics education requirements in order to meet standards for accreditation. As

Stein, et al., (1998) state, though NCTM and others advocate a more constructive social approach to learning mathematics through the use of reflection, learning communities, and other approaches, teachers have themselves never been involved in what can be described as learning communities at the school level (p. 19).

The Context of This Study

The policies that surround public education have a profound effect on the teaching of mathematics. First and foremost in current policy is a change in the expectations for the teaching and learning of mathematics. During the past twenty years, scholars and the general public have reported that we are in the midst of the "math wars." This reference has its grounding in a disagreement about the best way to teach mathematics and what is necessary to learn mathematics. In 1989, NCTM published the *Curriculum and Evaluation Standards for School Mathematics*, which moved the learning of mathematics away from rote memorization and basic computational skills to content knowledge, problem solving, and mathematical communication. In 2000, the *Principles and Standards for School Mathematics* specified the mathematical knowledge that students should learn in school, based on specific content and process strands. The hope was that this one resource would help to "improve mathematics education" (NCTM, 2000, p. ix), through reform in curricula, teaching, and assessment. Following the publication of the Principles *and Standards,* textbook publishers, states, and school districts began to implement these changes through the use of new standardized curricula, assessment, and learning expectations. These changes took the form of inserting into the curriculum more problem solving, collaboration, mathematical discourse, construction of knowledge, and

the use of technology in the teaching of mathematics. Recently, NCTM published the *Curriculum Focal Points for PreKindergarten through Grade 8 Mathematics* (2008), which focuses the mathematics curriculum on the most important mathematics topics that need to be developed in the hope of "improving the teaching and learning of mathematics" (introduction). Along with a changed view of teaching and learning mathematics, policies have hit on issues of quality teaching, the need for more teachers, the education of teachers both in-service and preservice, and the resources used in the schools.

Highly qualified teachers in urban schools. The No Child Left Behind (NCLB) Act (2001a) created new incentives for schools, teachers, and districts to move toward a standardized curriculum. The premise behind NCLB is that all children can learn and, therefore, all children have the right to a quality education. Schools can meet this quality education standard by demonstrating that they have made Adequate Yearly Progress (AYP) based on state standardized tests. In New York State, the standardized tests are based on the *New York State Learning Standards for Mathematics*. These standards are grounded in the ideas presented in NCTM's *Principles and Standards* (2000). For example, conceptual understanding, problem solving, and mathematical fluency are the three components that make up the process and content strands of the New York State Learning Standards for Mathematics (New York State Education Department, 2005). In order to meet these standards, many districts and schools have adopted mathematics textbook series that are grounded in these components. In New York City, the elementary public schools have adopted *Everyday Mathematics* (2004) which is a National Science Foundation funded curriculum (UCSMP, 2005). It is complemented

with *Math Steps*, an exercise review mathematics book. This program is meant to a take a balanced approach by "focusing on what students need to know, and the process and skills necessary to reason, solve problems, and think critically" (The NYCDoE, Department of Mathematics statement, http://schools.nyc.gov/acadmics/mathematics/default.htm). According to the University of Chicago School Mathematics Project, the creators of *Everyday Mathematics,* the *Everyday Mathematics* curriculum (2004) has some features that distinguish it from other elementary mathematics curricula. These features are real-life problem solving, balanced instruction, multiple methods for basic skill practice, emphasis on communication, enhanced home/school partnerships, and appropriate use of technology (http://everydaymath.uchicago.edu/about.shtml). The New York City Department of Education's (NYCDoE) Department of Mathematics has shown through the use of a pacing calendar how this course of study meets the *New York State Learning Standards*. The pacing calendar also contains an approximate time line of when certain units and topics should be taught. Furthermore, the NYCDoE instituted the math coach initiative to help teachers work with the new curriculum. These additional resources are available to make the teaching of mathematics more accessible to elementary school teachers.

Once the curriculum and standards have been chosen, the schools need teachers who can teach the material. NCLB requires that all students be taught by "highly qualified" teachers (No Child Left Behind Act, 2001b). High-poverty urban school districts have continually had problems in retaining teachers. In the 1990s, many teachers did not meet NCLB's requirements to be "highly qualified" (The Education Trust, 2003). The requirements that NCLB sets forth are as follows: a bachelor's degree

and demonstrated competency in content and writing skills shown by passing a state licensure test that leads to certification. One could argue that, by these requirements, all a teacher needs is a content knowledge in the area in which they are to teach, which does not coincide with one of the purpose of public education in the United States, that of preparing students to "reach the highest possible level of economic achievement" (Michelli, 2004, p. 69). Now there are more teachers meeting the "highly qualified" standard but are the students being given a quality education?

As a result of the attrition of teachers in urban schools, the shortage of mathematics, science, and special education teachers, and the need for "highly qualified" teachers, defined as certified teachers, the New York City Teaching Fellows (NYCTF) program was introduced in 2000 (http://www.nyctf.org/about/history.html). The Departments of Education of New York State and New York City along with the City University of New York implemented this alternative certification program, which has its participants teaching in the classroom after an intensive six-week summer program. During the first two or three years of teaching, participants pursue a master's degree in education in order to become fully certified teachers. This program may bring in only a small number of teachers in the grand scheme of things, although, for mathematics the percentages are astounding. Fellows accounted for approximately 10 percent of the New York City teaching force in the 2003-2004 academic year (Boyd, Grossman, Lankford, Loeb and Wyckoff., 2005). However, in 2004-2005, the fellows accounted for about 60 percent of *all* new middle and high school mathematics teachers in New York City. In the 2003 cohort, 30 percent, or about 725, of the fellows were elementary school teachers (Higher Education and Professional Practice Committee, 2004). The challenges in

meeting the work force needs of teachers in New York City public schools is further exemplified by the need to hire about 8,000 new teachers every year.

New teachers. Teacher characteristics have been studied extensively in terms of teachers' mathematical knowledge, their beliefs about teaching, and their practice in teaching and learning. Ma (1999) compared and contrasted elementary school teachers from China and the United States in terms of their mathematical knowledge. She found that the teachers from China had a deeper understanding of fundamental mathematics and a greater variety of techniques to use in the teaching of mathematics. Hart (2004) studied first-year elementary school teachers' beliefs about reform mathematics and found that, even with feelings of frustration, the teachers held on to the beliefs that "were consistent with reform practices" (p. 86). Moreover, the teachers were consistently able to integrate behaviors that supported their reform beliefs into the classrooms. This is not always the case, as was demonstrated in the study by Flores and Day (2006). In this case, the ways in which the teachers viewed teaching and themselves as teachers were challenged. The authors note that their teaching then "became more routine, more rule governed and less creative" (p. 230). So how do new teachers navigate working with the policies of reform curricula? Are they able to implement them or not? Through the use of reform curricula and techniques, studies have investigated ways to examine the teaching and learning of mathematics and, consequently, the students that they are teaching, with some success (Boaler, 2002; Carpenter, et al., 1996; Franke, et al., 1998; Sosniak and Stodolsky, 1993).

With the high turnover in teaching, many school districts are instituting methods of induction for new teachers. Ideally, induction is an important support system for new teachers. Many systems consist solely of the support of a mentor, who may or may not

be very helpful (Fulton, et al., 2005). One of the difficulties for first-year teachers is the concurrent establishment of a knowledge base about children's thinking and learning and of their own knowledge base as mathematics teachers (Vacc and Bright, 1999). Another difficulty is the assumption that using the teaching methods learned in preservice or in-service courses is often not possible in the reality of an urban classroom. Many teachers see the methods as exemplary teaching, but they do not see how to implement them in their classrooms because of problems with time management, their students' knowledge base, and material resources (Feiman-Nemser, 2001; Haritos, 2004).

Quality mentoring is essential for successful teaching and retention and a way to overcome the disconnect between teacher learning and teacher practice. As of fall 2004, all first-year teachers in New York City were assigned a mentor (The New Teacher Center, 2006). These mentors were trained in the format of a mentoring program implemented by the New Teacher Center at the University of California, Santa Cruz. In addition, the New York City Department of Education has implemented a policy that provides for specialist mentoring. As determined by the Children First Reform Agenda, one of the key reforms was the adoption of a system-wide approach to supporting mathematics instruction through professional development. Math coaches were placed in schools to mentor teachers in best practices for teaching mathematics based on the curriculum, the standards, and the assessments, as well as to give support when needed (NYCDoE, http://schools.nyc.gov/press/02-03/n36_03.htm, 2002-2003).

Certification programs/mathematics requirements. Some first-year teachers have approached teaching through the traditional preservice route with student teaching, while other first-year teachers may only have had a brief preservice experience, such as a

summer session. Based on their research data, (Boyd, Grossman, Lankford, Loes, Michelli, and Wyckoff, 2006) ask if it matters if elementary school teachers take a course in the teaching of mathematics before becoming a teacher of record or if they take the course during their first year of teaching.[4] Darling-Hammond, Chung, and Frelow (2002) found that teachers who had been enrolled in teacher education programs before teaching felt better prepared in most areas that confront teachers than those who entered teaching through an alternative path. No matter what route is taken into one's first year of teaching, a teacher needs to meet the expectations set forth by designers of the curriculum, by the school administration, and by the professional community. It has been shown that difficulties experienced by first-year teachers can be alleviated by effective mentoring, ongoing teacher development, and the building of a teacher community (Brett, et al., 1997; Bullough, 1989; Cochran-Smith, 2005; Culpepper, 2004; Darling, 2001; Ensor, 2001; Fulton, et al., 2005; Warfield et al., 2005). It is interesting to note that Boyd et al., (2005) found that the path taken into one's first year of teaching may affect one's initial ability to teach a subject. "[There] is some evidence that teachers that enter New York City elementary schools through these [alternative] pathways do not teach Mathematics or English Language Arts as well as teachers from the 'College Recommended' path during their first year" (p. 21).

Although very few elementary school teachers enter teaching through alternative certification programs, it is important to take a closer look at the differences in the pathways. Initially, these programs were developed to certify more teachers to teach in hard-to-staff schools. Before the development of various types of alternative certification

[4] This is not a research question in the Pathways study. It is a possible conclusion that can be drawn from the data they obtained (Boyd et al., 2006, p. 159).

programs, people were working in the schools with temporary licenses and emergency licenses. Because of the need for "highly qualified" teachers as prescribed by NCLB, many more states have shifted from using emergency-certified or uncertified teachers to alternative certification programs, in which the "highly qualified" guidelines are met. These new programs are meant to meet the demands for new teachers resulting from the phenomenon of teacher turnover (Ingersoll, 2001). Some of these programs are meant to attract a talented pool of people who graduated from more selective colleges as well as those who change careers (Darling-Hammond, Berry, and Thoreson, 2001; Higher Education and Professional Practice Committee, 2004; Proweller and Mitchener, 2004). The NCLB act defines a "highly qualified" teacher as having a bachelor's degree, full state certification or licensure, and being able to prove that they know each subject they teach and identifies ways in which states can enforce and meet this goal (NCLB, 2001b). The guidelines set out by No Child Left Behind try to lead the states toward rigorous testing for elementary school teachers. The teacher must show a high skill on tests evaluating "subject knowledge and teaching skills in reading, writing, mathematics, and other areas of the basic elementary curriculum" (U.S Department of Education, 2001, NCLB, Section 9101(23)(B)(i)). Many states use a multi-subject content specialty test for the elementary school teachers.

For teachers following an alternative route to teacher certification, the process may vary depending on the state. In New York State, for example, after the publicity of the Campaign for Fiscal Equity case in the late 1990s showed that over 10 percent of teachers were uncertified (Campaign for Fiscal Equity Inc., 1999), and the New York State Regents sued the City to meet the demands for certified teachers in failing schools,

an alternative certification program was implemented. The New York State Department of Education, the New York City Department of Education, and the City University of New York instituted the New York City Teaching Fellows (NYCTF) Program (Boyd et al., March/April 2006). The NYCTF program was meant to initially put certified teachers in these failing schools but currently the program helps to meet the need for teachers in areas considered to be "high needs" such as mathematics, science, ESL, and special education (http://www.nyctf.org/). A "high needs" area is one where there are not enough certified teachers to fill the open positions. The need for elementary school teachers was satisfied in the first years of the program.

The goal of the NYCTF program is to recruit qualified people into teaching. The participants come from all walks of life. According to the Teacher Policy Research Pathways study, some of the participants are recent graduates, while others are career changers (Boyd et al., 2005). The NYCTF participants begin their teaching career following six weeks of intensive coursework and fieldwork. This consists of 200 clock hours, of which 40 hours are in schools. Depending on the college of attendance, the summer coursework varies. After completing the summer coursework, participants become teachers of record in their own classrooms. Traditionally certified teachers become teachers of record after at least a semester of student teaching, which varies in its effectiveness. As beginning teachers, they (both traditionally certified and alternatively certified) are required to have a mentor within the school. Moreover, New York City Teaching Fellows have a university mentor. The Teaching Fellows have two to three years to complete a master's degree in education, at which time they become fully certified to teach in the New York City public schools, while a traditionally certified

teacher has up to five years to finish a master's degree. All teachers receiving certification in New York State must complete the same academic coursework requirements from approved universities. The NYCDoE selects the colleges for which the Teaching Fellows can be enrolled, but the Fellows must also meet the admission requirements set by the colleges. Once the Fellows have been accepted into an approved master's degree program, they take the same required courses as preservice and other in-service teachers. Some colleges mix the Fellows with other certification students, while others have separate course offerings for the Fellows.

This program is unlike programs in other states because there is a commitment to holding to traditional teacher education standards. These teacher education standards are set forth by New York State in accordance with NCATE (National Council for Accreditation of Teacher Education). The State requires education schools to have specific courses offered and taken by students to prepare them to be teachers. Candidates must complete a general education core in the liberal arts and sciences, a content core, and a pedagogical core. The *content core* requires that a candidate complete study in the subject(s) to be taught "which shall prepare candidates with the knowledge base to teach the subject(s)" (pp. 11-15 of school accreditation requirements). The *pedagogical core* requires or permits candidates to obtain the following skills: human development, learning processes, information on special needs students, language acquisition and literacy development, curriculum development, use of technology, assessing student learning and teaching practice, history and philosophy of education, updating knowledge, child abuse issues, and prevention of child abduction. These core studies are taught in conjunction with field experience (NCATE, 2006). For teaching childhood education

(grades 1 – 6), "the content core shall be a major, concentration or the equivalent in one or more of the liberal arts and sciences" (pp. 11-15 of school accreditation requirements). In childhood education, seven areas of general knowledge must be met. These seven are the Arts; Career Development and Occupational Studies; English Language Acquisition; Health, Physical Education and Family and Consumer Sciences; Languages other than English; Mathematics, Science and Technology; and Social Studies. The only difference between the traditionally certified and alternatively certified programs is the sequence in which the courses are taken, when the fieldwork occurs, and when the teacher is in the classroom. The different paths to teaching in New York City all have one thing in common: the schools that the participants attend must already be accredited in teacher education by some accrediting agency such as NCATE, or have had an accreditation visit by December 2006. According to NCATE, they all must meet the following standards of development: learning, motivation, curriculum, instruction, assessment, and professionalism (NCATE/ACEI, 2006). Specific to mathematics, teacher education programs must adhere closely to the NCTM Standards:

> Candidates know, understand, and use the major concepts, procedures, and reasoning processes of mathematics that define number systems and number sense, geometry, measurement, statistics and probability, and algebra in order to foster student understanding and use of patterns, quantities, and spatial relationships that can represent phenomena, solve problems, and manage data. (http://www.acei.org/Rubrics.htm, ACEI Standard 1 Rubric)

Past research studies have investigated whether or not teachers from alternative pathways

are teaching mathematics effectively (Ball and Wilson, 1990; Boyd et al., 2005; Darling-Hammond et al., 2001), and often the alternative pathways are compared with the paths followed by traditionally certified teachers. Ball and Wilson (1990) found that neither the alternatively certified teachers nor the traditionally certified teachers in their study had the mathematical content knowledge necessary to teach mathematics effectively. Darling-Hammond (2005) found that after four years there was no difference in mathematics achievement of students. However, in the first three years, students who had alternatively certified teachers fell behind in mathematics achievement, as measured by standardized tests. The Teachers Policy Research Pathways Project (Boyd et al., 2005) found that "Teaching Fellows and [Teach for America participants] perform well relative to other pathways in middle school mathematics." More specifically, in elementary school mathematics, "after a poor first year, the Teaching Fellows do approximately as well as teachers from all other routes except for the 'college recommended'" (p. 24). By "college recommended" this study means that the teacher must complete a university-based program that is registered with the State of New York.

Standardized curriculum. There has been a trend toward a standardized mathematics program for many reasons. The key motivation in urban districts is that because of increased mobility of poor minority students, the adoption of a standardized mathematics program or textbook allows the students the opportunity to learn the material without disruptions even if they change school midyear. Standardizing a mathematics program also allows for increased accountability of students and teachers. Within New York State, there are specific process and content standards that have been laid out for each grade level. Assessment of these standards has been developed and administered to determine whether the standards have been met. The mathematics

textbook and all the teacher resource materials that come with it, are important tools that can help a teacher in the process of teaching mathematics. How does a new teacher, lacking experience, appropriate these resources? Research has shown that emphasis should not be placed solely on textbook materials as they are not the only influencing factor in teaching a subject (Proweller and Mitchener, 2004). Nonetheless, a teacher's ability to reflect on a textbook as a resource material is a valuable tool, particularly in a time of standardized curricula (Sosniak and Stodolsky, 1993).

Professional development. These new reforms impose a need for professional development in order to provide the support for effective implementation of the reforms and programs. Aspects of this support that have been successful include coaches, mentors, professional development, such as lesson study, and improved working conditions and resources (Fulton et al., 2005). One's education as a teacher does not end with certification or a degree. With this need to support new teachers and considering that many teachers have not gone through a traditional path to teaching, professional development has become a formalized way to continue teacher education. Some of these supports may not reach the teachers and students who would benefit most from them. With the introduction of new curricula comes the need for professional development in the use of the specific curriculum. The Algebra Project, which was not implemented in New York City, was successful in many districts because of the necessary support through professional development for all teachers (Moses and Cobb, 2001). Similar successes were found with the implementation of other curricula in which communities of teachers were built to work through the lessons and to reflect on their teaching (Boaler, 2002; Brett et al., 1997; Franke et al., 1998).

CHAPTER 3

RESEARCH AND METHODOLOGY

To create a laboratory to study teacher practice in the teaching of mathematics, teacher reflection, and teacher identity, I formed a community of practice. This community of practice served as a forum where teachers could work on aspects of their mathematics teaching. This chapter describes the research questions, the design of the research, the participants, the data collection, the data analysis, and my role in the research.

Research Questions

In formulating the questions that I wanted to answer, I used my own teaching and learning experiences. Why, when I am asked what I do for a living, do I say, "I am a math teacher?" I know that the subject I teach is mathematics and that I have taught it at many levels. But how is the way I see myself different from how an elementary school teacher who also teaches mathematics sees himself or herself? This question drove me to conduct my research with elementary school teachers who teach mathematics. But why did I choose to look at *new* elementary school teachers? Being informed, as a result of my studies and my fellowship, of the many policies related to curriculum, mentoring, assessment, and professional development that affect teachers in the New York City public schools, I decided that I needed to look at how these policies affected elementary school teachers. Furthermore, since the New York City school system hires at least 1500 new elementary school teachers every year, it was important to do this research with a

specific group of professionals involved in the challenge of beginning to teach in the New York City public school environment. Finally, my choice of using a community of practice as part of my research methodology grew out of my own experience in teaching. Much of my learning about teaching, curriculum, pedagogy, mathematical pedagogy, and children occurred in what can only be described as a community of practice where I first began learning from professionals who were more experienced and knowledgeable about the teaching of mathematics than I was. Being increasingly able to control my learning about teaching became a significant part of my own professional experience. This experience gradually led me to greater participation in and to sharing my own newly acquired knowledge about teaching and mathematics with my peers as well as my mentees.

The research questions, formally presented in chapter 1, were formulated before the research began, and I will discuss the difficulties, limitations, and outcomes of these research questions in Chapter 5. Through this designed research, I hoped to continue the education and reflection of the teachers who participated in the study in relation to their mathematics teaching. Furthermore, I hoped to shed some light on the following questions:

- How did these new elementary school teachers experience the teaching of mathematics given the structures of urban schools?
- How did a community of practice help to transform their identities as mathematics teachers?

My involvement in this study, the path taken to certification, and mathematics practice are all additional areas that are addressed in the research questions. I hoped that the

experience of working with an experienced mathematics teacher and participating in a community of practice would transform these teachers' identities as mathematics teachers by giving them more agency in their mathematics teaching.

Research Design

To help answer these questions, I formed an intentional community of practice with first- and second-year elementary school teachers. The teachers met with me as a group approximately once a month for four meetings. During these group meetings, the participants watched video clips of their teaching, worked on mathematics problems, and discussed topics related to mathematics and teaching. The participants and I chose the clips and the topics of discussion. The group meetings were conducted as a way to further the professional development of these new teachers in the areas of mathematics, mathematics teaching, curriculum understanding, and policy.

In addition to the group meetings, I conducted bi-monthly observations of the mathematics teaching of each teacher in the group. The documentation of the observations was facilitated by video and audio recordings. During the observations, I participated in the classes as an additional mathematics teacher for the students and as a mentor for the teacher. After each observed class, I conducted an informal interview with the teacher, which usually resulted in the teacher asking me how best to improve his or her teaching based on what I had observed. After making the observations, I wrote a brief description of the class that I observed with reflective questions and comments throughout. The teacher was asked to write a reflection of the class that was observed as soon after the class as possible. The background design of the research was an

ethnographic study with a participant-observer approach. This type of research entails two important components: one is having the researcher completely involved in the setting and with the people who are being observed; the other is having the researcher record on a regular basis what is observed and learned from participating in this setting (Emerson, Fretz, and Shaw, 1995). Furthermore, this research had a participatory action component to it in that my actions within the community were meant to improve the experience of the participants involved. The participants had a role in how the study unfolded through their reflections and involvement in the community of practice. There was direct participation and reflection on the part of both the researcher and the teacher. At its core, action research is a way to increase understanding of how change in one's actions or practices can mutually benefit a community of practitioners (Reason and Bradbury, 2001). Finally, this research incorporated the design of case studies in that the three cases were bounded by the activity of the group. These were individual cases that were studied separately but also were brought together and studied as a group (Creswell, 2003).

Before the first observation of a class taught by each teacher, the teacher completed a participant history. Part of this document was based on the MetroMath at the City University of New York Macro study of the New York City Teaching Fellows (Cooley et al., 2006). The specific responses in this document informed me of the participants' mathematics background based on the courses taken at the secondary school and post-secondary school levels. Other demographic information about the teachers was gathered from the survey, such as college attendance and degree, information about the school at which they were teaching, and information about the graduate teacher education

program in which they were enrolled at the time of the study. The other part of the participant history was derived from the life story interview protocols conducted by Drake, Spillane, and Huffer-Ackles (2001). Their protocols were derived from McAdams (1993). The questions that are important to this study were those that asked each participant to describe a key event in his or her mathematical schooling, either positive or negative, that is to describe a peak experience where he or she had emotions of happiness or joy, or feelings of success, or a low-point experience where he or she had feelings of failure. The participants were asked to consider what the answers to these questions would be at different times in their educational experience, either at the elementary school level or at the secondary school level. They were also asked to describe their relationship with mathematics as an elementary school teacher and also what they believe a high school mathematics teacher's relationship with mathematics is or should be.

Participants

I chose three participants who volunteered to be a part of this study. They were informed about it through e-mails or letters I sent to graduate students in childhood education at the same university. The research project was described as an opportunity to build a rewarding mathematics learning community for a small group of elementary public school teachers so that they would have the opportunity to learn and reflect on their own mathematics teaching practices (See Appendix B). In order to be selected for this study, the participants needed to be in their first or second year of teaching at the time of the study. They had to be teachers in a New York City public school and be

elementary school teachers teaching third through fifth grade. Furthermore, I was interested in having participants who were being certified through various pathways. They were all students at the same urban university, which provided some commonality in their formal teacher preparation experiences. Two of the participants (Jessica and Julia, pseudonyms), were enrolled in a master's degree program in childhood education while being participants in the New York City Teaching Fellows Program. The third participant (James, pseudonym), completed his undergraduate degree in childhood education and at the time of the study was enrolled in a master's degree program in childhood education with a specialty in mathematics. Jessica taught third grade in a large urban elementary school in the southeast section of the city; Julia taught fifth grade in a large urban elementary school in the eastern part of the city; and James taught third grade in a medium-sized elementary school in the eastern part of the city.

I, as a researcher, was part of the study in many ways. First, I was a participant-observer during the teacher observations. I actively took part by walking around the class and helping students during group activities. There were a couple of times in each of the teacher's classes where I became aware that a student had a specific question, and I brought that to the teacher's attention. I recognize that my immediate involvement in the classroom environment affected the teaching that occurred when I was there, even to the extent, in so far as Julia was concerned, as she mentioned in both reflections and the group meeting, that she seemed to prepare more for lessons on the days that she was being observed. Second, in the observations, post-observation interviews, e-mail correspondence, and group meetings, my participation influenced the work of these teachers. In the post-observation interviews, the interaction occasionally took the form of

teachers asking me questions to help them improve their practice, as if I were a mentor. During e-mail correspondence, the teachers might ask questions about how to follow up on a previous lesson. In the group meetings, my intention was not only to gather information to inform this study but also to support the teachers in their teaching of mathematics. Finally, based on my own prior experience as a mathematics teacher and researcher, I was interested in how this study influenced me and changed my perceptions. With all of this in mind, it is important that I include an analysis of my role in this study.

Permission and Other Research Concerns

This study is primarily about the teachers and the community of practice in which they took part, and I received written consent from these teachers with the understanding that all information that was divulged in the meetings remain confidential. Another large part of the study involved the observations in the classroom. I did not see any way to work with the teachers and their mathematics teaching unless I had some connection to the students in their classes. Since the classes were being video recorded, written consent was required from the New York City Department of Education, the regional superintendent, and the principal of the school and the parent/or guardian of each student in the class (See Appendix B). Those students who did not give permission to be video recorded were not filmed. If, for some reason, their faces or any identifiable likeness appeared on film, that clip was deleted from the data. Occasionally, the backs of their heads were filmed. In all of the observed classes, only five students refused permission to be video recorded. In addition to the above permissions, I obtained the required permission from the City University of New York Institutional Review Board.

For the purposes of this study, teachers, schools, and, if applicable, students are identified with pseudonyms. All identifiable characteristics have been made as generic as possible. All data that were collected are stored and are in my possession. No one else, aside from my dissertation adviser, had access to the data during the analysis or writing period. As was stated previously, the participants all watched one another's video clips, but they agreed to maintain confidentiality about all participants in the study.

Data Collection

The focus of the data collection was on the teachers' experiences of teaching mathematics through understanding, continued learning, and reflection supported in the community of practice/inquiry. The data sources included over nine hours of video per teacher for the classroom observations, nine reflections per teacher, and over ten hours of video from the group meetings.

Observations. The observations of the teachers' mathematics teaching were conducted two to three times a month. Each of the schools saw me as a mentor for the teacher, and the students recognized me as another mathematics teacher to help them with their work. These visits provided specific information about the learning environment in which the teachers were teaching and the students were learning. The teachers' behaviors and practices were noted. As I walked around helping students and observing the class, it proved to be a challenging endeavor to carry the video recorder around with me, recording the teacher. Occasionally, I would prop it at the back of the classroom so that it recorded the entire class. In addition, I would help the teacher if I was asked to do so; this help came in the form of either clarifying a term or answering a question that the

teacher had while teaching. The video recordings were mailed to the participants as soon after the observation as possible in order for them to have an opportunity to view the videos and choose a clip to use during the group meetings. This aspect of the video recording gave the community of practice a concrete piece of teaching to observe and discuss for each teacher.

Post-Observation informal interview. Informal post-observation interviews were conducted after the observations, if possible. Depending on the teachers' schedules, an interview would occur immediately after the observation. More often than not, these interviews/conversations occurred by e-mail before the next observation. The informal interview helped bring to the fore key points about the class that had been observed. Often, this was the beginning of the teachers' and my reflections related to the class. These immediate discussions led to my suggestions and comments and to questions and comments from the teachers. Types of comments that occurred during these post-observation interviews were about classroom management, the best way to follow up on a lesson, recognizing that something (i.e., mathematical content) was missing in the previous lesson, and how to work with the curriculum.

Field journal. After each observation, I wrote down what I had observed. Since I could not take written field notes during the observations. These writings turned into more of a reflection. This is similar to what Emerson, et al., (1995) refer to as "reflexivity," where the researcher is aware of the choices made in what to write. The researcher is not just "simply recount[ing] the tale of something that happened but instead is reconstructing 'what happened' so as to illustrate a pattern" (p. 211). I specifically noted how the teacher conducted the lesson, used the *Everyday Mathematics* curriculum,

questioned the students, and talked to the students. I also noted when I might have done something differently, not to judge the participants in their teaching but to register my own "feelings" or "experiences" with the lessons (Emerson, et al., 1995). At the end of each account, I wrote down questions that I wanted to pursue during the community of practice. Since a focus of this study was related to identity, many of my questions in the field journal took the form of "what does this have to do with the teacher's identity?" or "what does this have to do with a mathematics identity?"

Teachers' reflections. Each of the participants completed a "reflection" or a "journal entry" after each observation. If I conducted two consecutive observations (e.g., on Monday and Tuesday), the teacher may have written only one reflection. These reflections focused on the following questions:

- What did you like about your mathematics class today?
- What do you think worked well with the students and why?
- What do you think did not work well and why?
- What resource(s) did you use to teach this mathematics lesson? (math coach, graduate class, peers, curriculum and so on).
- Do you think the resources were helpful or not helpful?

Moreover, based on the informal interviews, the teachers often reflected on the class in relation to what was discussed after class. The reflections were e-mailed to me and sometimes led to a continued e-mail dialogue before the next observation. These reflections were helpful to the teacher in that the he or she became more aware of his or her teaching, the curriculum, and the mathematical content. These reflections were also useful in that they focused attention on a specific clip to be chosen for the group meeting,

helped to plan the agenda for the group meetings, and enabled me to give pedagogical and mathematical feedback to the teachers. I kept copies of all of the reflections and e-mails that were related to the reflections or were questions about teaching.

The use of reflection in a teacher's development has been supported for almost a century, but its importance increases and decreases with other trends in teacher development. Dewey (1997/1910) originally wrote that the purpose of teacher education was to inform and educate teachers on their practice. He modeled his ideas about teacher education on the reflective practitioner. Ball (1996) stresses that a certain type of knowledge for teaching is to be able to reflect on the teaching that is happening then. In other words, while in the classroom, teachers should consider what problems they could work on as a class based on the previous twenty minutes of class. Some writers define this as the ability to assess the students. Other models of reflection are based on using tools for reflection, such as video clubs, professional learning communities, and lesson study, where the teachers reflect on their teaching while discussing specifics about teaching in the context of the classroom (*Building Professional Learning Communities*, 2007; Sherin and van Es 2005; Stigler and Hiebert, 1999).

Group meetings. After I had observed each of the teachers at least twice, all of the teachers and I gathered for group meetings. These meetings were held in a neutral place, a small conference room at the City University of New York Graduate Center. The meetings occurred after work and lasted about two-and-a-half hours. They were video recorded with a camera that was mounted on a bookshelf and usually had a view of all of the participants except me. (Occasionally, I would also be in the recordings.) The format for these meetings was to begin with a brief activity that was mathematics related

(See Appendix A). This exercise was designed not only to provide the teachers with additional resources but also to enable each participant, including me, to observe their peers doing mathematics. This exercise was followed by the watching video clips of each of the teachers. The rest of the agenda for the meetings varied from meeting to meeting depending on the topics that the participants wanted to discuss or issues raised from the video clips that were chosen. A commonality of all four meetings was that a three- to ten-minute clip was chosen of each teacher's teaching. These clips came from one of the two classes that were observed before the group meeting. The teacher or I chose these clips. Occasionally, the clip was chosen in agreement between the teacher and me based on the informal post-observation interview. The choice of clip depended on a couple of factors but were not limited to these: mathematic content, pedagogy, student behavior, or curriculum use. These clips were followed by discussions about teachers' practice in the classroom. The group meeting tended to deal with one "issue" affecting the teachers' work, such as mathematics teaching, curriculum, pacing calendar, classroom management, math coaches, or communities of practice.

These meetings became an environment where the teachers sought support in their experiences. They would recount stories from their day or week, as a way to decompress. Sometimes these conversations would occur while waiting for the full group to assemble. Initially, these stories helped the participants get to know one another better and make connections. Not only did the group meetings serve as a support group where ideas were shared and encouragement was offered; they offered opportunities for teacher learning based on the teachers' practices and their current knowledge based on inquiry (Feiman-Nemser, 2001).

Video clubs. Since each of the group meetings had as its crux the viewing of three video clips, it is relevant to discuss teacher development research that uses video clubs or case studies for reflection and learning. There are a variety of reasons that I chose to use video clips of the participants. The premise that the group meetings were a community of practice enabled me actually to look at the practice of the teachers. In a school-based professional community, the usual format is for the teachers to observe one another's classes and learn from their teaching with a commitment to inquiry and critique (*Building Professional Learning Communities*, 2007; Feiman-Nemser, 2001). Inasmuch as the participants were all teaching at different schools, they did not have an opportunity to observe one another teach. Furthermore, the video recordings gave the teachers an opportunity to continue to reflect on their teaching long after it took place.

For the purpose of this research, it was important to have a forum both for me to learn what the participants were thinking about teaching mathematics and about mathematics, as well as for the participants to reflect and learn. Because this research was presented to the participants as a way of being part of a mathematics learning community in which they would have the opportunity to learn and reflect on their own mathematics teaching practices, the use of video became more than just another data source for analysis. Of course video also became a direct way to examine what was happening during a lesson.

Sherin (2003) discusses how "video clubs" help in teachers' reflective practice. A "video club" as defined by Sherin and van Es (2005) is a group meeting in which participants are involved in discussions about videos of their own teaching. Sometimes the organizer chooses the videos, but most often the teachers themselves choose the video

clips. More specifically, Sherin and van Es have created a framework to look at the development of the participants involved in the video clubs. In level 1, the teachers only notice superficial occurrences in the class; in level 2, the teachers notice more specialized events in the class; in level 3, the teachers focus on one particular approach to mathematics thinking and move toward looking at the details behind the students' thinking; and finally, in level 4, the teachers extend their observation to the relationships that they have with the students in relation to the students' knowledge. This framework led Sherin and van Es to report that over time the participants began to shift their focus from "noticing" different aspects of their pedagogy to aspects of their students' thinking (Sherin and Van Es, 2005).

There are many other ways that Sherin and her colleagues have studied "video clubs." The benefits of an interactive "club" in which the researchers and the teachers increased their communication in productive ways were also shown to "help shape the understandings of all participants of what took place in the classroom" (Sherin, 2003, p. 33). In Sherin and Han's work (2004), the teachers involved in a video club began to see different issues occurring in classroom interactions and discussed approaches to investigating both pedagogy and student conceptions or misconceptions.

Data Analysis

I began to analyze the data while I was conducting observations and group meetings. Informally, analysis started with the writing of reflections and notes geared toward the research questions. When writing my reflections after the observations, I often noted such questions as "What does this have to do with identity change?"

Furthermore, I often questioned my role in this research. The teacher may have presented a lesson a certain way and in my reflection I would write how I would have done it differently. This reflection became an important part of the research because I realized that my role was changing throughout the course of the study. I was not just a facilitator in the group meeting and the mathematics professional in the classroom, but also a mentor in and out of the classroom. This informal analysis led to formation of some of the topics of discussion for the group meeting.

Once all the data were collected, I looked at each participant's reflections and related e-mail correspondence. I reviewed the instances of "I" statements and "they" statements. When referring to these statements, I was looking for control in what they were teaching, noting such phrases as "I decided to," or "the book said to," or "They do it this way." After looking at the reflections, I viewed the videos to see what type of language emerged during the community of practice when both the researcher and the participants were talking about mathematics and doing mathematics. I again looked for instances of "I" and "they" statements to see how the interactions between the participants were changing and what actions occurred as a result.

I then analyzed the video recordings of the four group meetings. I started this analysis by conducting an initial viewing of the video and pulling out key conversations that I wanted to look at in greater depth. These key conversations had instances of active dialogue, reference to resources, reference to mathematics or mathematics teaching. I transcribed and then coded these conversations. I was specifically looking for the content of the teachers' conversation, so I initially coded for mathematics, curriculum, policy, and identity. This coding was based on what was stated in the transcribed text. Dialogue

that mentioned *Everyday Mathematics* was coded for curriculum; any mention of coaches, mentors, or assessment was coded for policy. What I noticed was that other codes began to emerge, such as student behavior, change in teaching, why they picked the video clip, comments that I specifically influenced, and, of course, "other." Not only did the coding emerge from the data, but also patterns began to emerge; for example, the occurrences of the talk under specific codes changed from the first group meeting to the last group meeting. This analysis was supported by the participant history taken at the beginning of the research and my reflections from both the class observations and the group meetings.

When analyzing these data, I gathered information that would lead to some conclusion about who these new teachers were and how they thought about mathematics and the teaching of mathematics. In addition, I gathered information about these teachers in relation to their schools and to the study. I am presenting a story of three participants or, as some would refer to them, case studies. Research in the form of case studies informs teacher learning and identity transformation (Bullough, 1989; Flores and Day, 2006; Roth, 2006b). Following a story or narrative of a participant's development is a way to inform others about a teacher's practice, and therefore, to have others ask about teaching and the benefits or lack of benefits of certain models of professional development. In Bullough's (1989) case study of a first-year teacher, the teacher, Kerri, is not "every teacher," but, as is stated, this is a specific case study that will help to inform others of the problems that first-year teachers face.

Analyzing My Role

My participation in this study strongly influenced the conduct of the participants. Their interactions with me in the classroom and in the group meetings played an important role in their transformation. My intent at the beginning of this study was for me to be the mathematics person in the classroom, walking around and helping the students, and an authority on mathematics during the group meetings. This role changed gradually as the term progressed. I did play the role as mentioned, but I also became more and more of a mentor involved in pedagogy and content knowledge as well as overall school issues. Occasionally, during the observed classes, the participants would look to me for reassurance that they were teaching a topic correctly or even ask me to share my thoughts with the students. At other times, they commented on how they prepared more because they knew I was visiting on a certain day. With this in mind, I analyzed the data (i.e., video and reflections) to determine the specific ways in which I may have influenced the group. I also analyzed the group-meeting videos to see how my perceptions may have changed over the course of the research.

Organization of Findings

In the following chapter, I will briefly describe the community of new teachers. In describing this community, more description will be presented on each of the participants and their schools. Following this, I will examine the work of the community and some important discussions that occurred in the specific meetings. As the analysis progressed, the following categories became prominent: ownership of the curriculum, relationship with mentors/math coaches, and topics related to being new teachers. These

three categories were foremost in the coding because of the policies affecting this study. In writing a description of each of the participants, describing their views on and interactions with these policies is important to understanding the experiences of these new teachers in the New York City Public Schools. The research questions that ask about the participants' possible change in identities in relation to being a part of the community of practice led to an analysis of the discourse in the community of practice. Referring back to my specified characterization of identity as dynamic, socially and internally constructed, and influenced by one's actions, I will describe the participants' possible identity transformation in relation to their involvement in the community of practice. Finally, I will present the participants' discussions about and experiences with mathematics and mathematics teaching.

CHAPTER 4

FINDINGS

The policies affecting new teachers in the New York City public schools are many. For a new teacher to navigate through current required reforms, a strong mentoring or support system is needed. However, research shows that in addition to needing support, new teachers tend to teach as they were taught and fall into the imbedded cultures that already exist in the schools (Ball and Wilson, 1990; Bullough, 1989; Warfield, et al., 2005; Wilson and Ball, 1991). The literature led me to believe that creating a community of practice in which new teachers talk about their experiences with the policies that affect them, mathematics, and mathematics teaching with an experienced mathematics teacher might help them to improve their teaching practice within the structures of urban public schools. Furthermore, I expected to find that participating in a community in which mathematics is explored and discussed in conjunction with the new *Everyday Mathematics* curriculum might enable new elementary school teachers to identify themselves as mathematics teachers.

What follows is an introduction to the community of new teachers and how and why they came together for this professional development. I refer to this research as a form of professional development because, as defined, professional development is a way of continuing education in relation to one's profession. Many state education departments and school districts encourage professional development for teachers as a way to ensure that teachers have the skills and knowledge to teach a specific curriculum. For this study, the curriculum is *Everyday Mathematics* (2004) which is a National

Science Foundation funded curriculum that focuses on real-life problem solving, balanced instruction, multiple methods for basic skill practice, emphasis on communication, enhanced home/school partnerships and appropriate use of technology (http:// everydaymath.uchicago.edu/about.shtml, 2005). According to the Everyday Mathematics website, *Everyday Mathematics* is "a comprehensive pre-kindergarten through 6th grade mathematics curriculum developed by the University of Chicago School Mathematics Project, and published by Wright Group/McGraw-Hill" (http://everydaymath.uchicago.edu/). In addition, the Department of Mathematics of the New York City Department of Education created a pacing calendar to show how the required curriculum meets the *New York State Learning Standards* as well as giving an approximate time line of when certain units and topics should be taught. To understand this community of new teachers, supporting data were obtained from both the participant history surveys and e-mail correspondence. In addition to wanting more professional development, the teachers who became part of this study did so knowing that they would be part of a mathematics learning community in which they would learn about and reflect on their own mathematics teaching practices.

After introducing the setting of this research, I examine the work that transpired for each individual participant in relation to use of the curriculum, policies, and mathematics. Additional topics came up for each individual over the course of the study and these instances, changes, and issues are discussed where appropriate. The initial analysis is based on post-observation interviews and reflections of the classroom observations. Using the research on new teachers' practice (Ball and Wilson, 1990; Warfield, et al., 2005; Wilson and Ball, 1991) which demonstrates teachers' lack of self-

sufficiency, I analyze the participants' discourse in relation to what they are referring to when instances of "I" statements or "they" statements are used. The participants' use of different statements shows where they felt sufficiently comfortable to make decisions in their teaching. Furthermore, I discuss each of the participant's relation to mathematics as mathematics is practiced in the classroom and the group meetings. Following the individual analysis of the participants, I analyze the community of practice bearing in mind the effects the community had on each of the participants. More specifically, I examine how the discourse and experiences shifted over time for the group and for each of the participants. Items that were coded were drawn from the video recordings and meetings. Through the outcomes of the coding, I grouped the responses for the findings of this chapter. I show that as the meetings progressed, the new teachers in this study began to become more critical of their own teaching, and that they became more comfortable adjusting lesson plans and taking ownership of their work in the classroom. Finally, I show the need for increased mentoring, support, and communities of practice based on the experiences of the new elementary school teachers who participated in this study.

The Community of New Teachers

Getting participants. Possible participants were informed of this study through e-mail or letter and were told that the study would consist of observations and group meetings that "would give participants the opportunity to be involved in the learning and reflection about teaching elementary mathematics" (See Appendix B). Requests for participants went to the New York City Teaching Fellows who attended an urban

university and to students/graduates who were in childhood education courses at the same urban university. Since I was interested in having participants who were being certified through both the NYCTF program and had been certified through the traditional route.

It was difficult to get participants for this study who were currently teaching in a New York City public elementary school, were in their first or second year of teaching, and were teaching in third, fourth, or fifth grade. It is important to note that in the proposal for this research project, the original intention was to have participants who were in their first year of teaching. Because of the difficulty in getting first-year teachers, I included second-year teachers, and I do not think that this shift diminished the importance or value of the study. After sending out e-mails to all the first-year teaching fellows, I received only three responses. Initially, one of the teachers was enthusiastic about participating in the study but two weeks after agreeing to participate, and meeting the requirements for the study, her principal took her out of her fifth grade class and placed her in a third grade class. This occurred because a teacher in her school quit teaching three months into the school year. She felt completely overwhelmed and "turned upside down" and did not think she would have time to be a part of the study. After sending out letters to students and graduates of the urban university, I received about seven responses. Of these responses, only one participant met the requirements for this study. I considered looking into other urban universities for participants but decided that the commonality that all of the participants attend the same college would be important for discussions in the group meeting.

Some of the difficulties in getting participants will be discussed later, but briefly, two possible reasons could be the perceived extra time commitment required and the

comfort level one has with mathematics. Once I had the commitment of my first participant, I enlisted her help to try to find other possible participants. The difficulty of this task was expressed by the comment that other new teachers might not have the same positive connection to mathematics and that the topic of mathematics might scare them off (Julia, informal discussion, 1/5/07). Furthermore, while at another participant's school, I was introduced to a fellow new teacher. This teacher taught third grade and was a New York City Teaching Fellow. When asked about possibly participating in the study, this teacher stated she had no time on top of everything else she was doing as a new teacher, teaching fellow and a commuter.

The participants. The participants in this study included three new teachers (i.e., Julia, Jessica, and James, all pseudonyms), who were attending the same urban university for their master's degree in childhood education. Because of the nature of the research, I also was a participant in the study. The three teachers volunteered to participate and received a stipend. Some of the initial reasons that they gave for being a part of this study were:

- To understand better why he was making the choices he was making in the classroom with regard to the curriculum of *Everyday Mathematics* (James, e-mail correspondence, February 2007). He also stated, "I'm just trying to become a better math teacher, a better teacher overall; that's why I chose to do this; I know that this is only going to help" (Group Meeting 3/1/07).
- For her love of mathematics and just working in an environment in which mathematics and mathematics teaching were the topics of discussion

(Julia, informal discussion, 1/05/07). When conveying this information, Julia was comparing herself to other teachers who "just aren't comfortable with mathematics."

- Because of the lack of information regarding mathematics teaching provided. Although, Jessica believed her strength in mathematics was an asset, she acknowledged the need for more information regarding pedagogy (Jessica, e-mail correspondence, February 2007).

These reasons became more complex as the meetings progressed in relation to teaching for conceptual understanding. Furthermore, the rationale for participating seemed to have some connection to the fact that all three of the participating teachers expressed an interest and liking for mathematics, either because of good grades or satisfaction from getting the right answer. For James, when describing a peak experience at both the elementary school and secondary school levels, he described performing well on tests. A difference for James was that he also described how he was "always good at helping my classmates who were struggling [with math]" (James's Participant History Survey, January 2007). The other participants also expressed a love for mathematics because they were always good at it in school, which they equated with doing well on tests. However, both Julia and Jessica explained how on entering higher-level mathematics, they struggled. This is reflected in both Julia's and Jessica's statement about mathematics on their individual participant history surveys:

> The only other time I remember [being] frustrated with math was after the [Sequential] III test, when I was placed into Pre-Calculus. I did have a good teacher but all of a sudden I really didn't understand anything, and I just got by

> with a C in the class. My image of college math was damaged then and I refused to take AP Calc or Stat or any Math in college. (Julia, December 2006)

> I was in a statistics course and you had to get a B+ or better in order to be placed in the advanced placement calculus course the next semester. I was truly struggling in that course and no matter how hard I tried to teach myself and go for extra help, there were just some concepts that I could not grasp. (Jessica, January 2007)

Not only was their interest in mathematics strong, but their enthusiasm for teaching mathematics was also apparent in their participant history surveys. James described his relationship with mathematics as a teacher very enthusiastically. "I love it! I love teaching [mathematics] and I love hearing a kid say 'ooohhhhhhh, I get it now' and seeing their eyes light up when I was finally able to relate the material for them to understand it" (James's Participant History Survey, January 2007). Julia stated enthusiastically in her Participant History Survey (January 2007) a similar love of mathematics and the joy of teaching it to students in order for them to understand it. Jessica did not express as much enthusiasm or strong feelings about teaching mathematics, but she did say that mathematics is one of her favorite subjects to teach. The reason she gave for this is, "I feel like it is concrete enough to be easy for me to relay information and yet abstract ideas and thinking can be added to it to make it more interesting and thought-provoking" (Jessica's Participant History Survey, February

2007). Although, Jessica makes this statement, in a majority of observations her teaching is more procedural and concrete as opposed to abstract and "thought-provoking."

Looking further into the responses of participants in this study led to some conclusions about the structures that are in place or not in place for successful participation in professional development. This is to be discussed in Chapter 5.

Jessica

Jessica, an African American female, is a recent graduate of a New England liberal arts college, majoring in sociology. She always considered mathematics to be her favorite subject because she "always seemed to get it" and she "was always able to teach [her]self." This drive and enthusiasm for mathematics continues in her teaching today: "Now that I am a teacher, I see math as the easiest subject to teach even if I have to teach myself something before I teach them" (Participant History Survey, January 2007). She entered teaching by becoming a New York City Teaching Fellow. The Teaching Fellows Program was an opportunity for her to do something for a community that was similar to the one in which she grew up.

At the time of this study, Jessica was in her first year of teaching at a large urban elementary school in a middle class African American community. The student composition of the school is about 95 percent African American, and there were about 175 students in the third grade. Jessica described her class as mostly African American and Caribbean American. Jessica stated that she had one English Language learner (ELL) and two English as a Second Language (ESL) students. Jessica equated the common language background between herself and the parents with having had excellent communication with a large number of parents. About 65 percent of the students at this

school scored three or four on the New York State mathematics test. Jessica found her position of a third grade teacher at a job fair. She found the school to be a place "that thrives on the success of our students. It is really working towards being one of the best schools in the district" (Jessica's Participant History Survey, 12/06). Jessica's class consisted of about twenty third graders.

As the year progressed, Jessica began to find it a bit difficult working at the school, mainly because of the decisions being made by the administration (e.g., disbanding the step club, an after school activity), but she continued to enjoy the collegial environment among her colleagues. She mentioned that her math coach met with her on a consistent basis and helped with planning and pacing, but Jessica still felt that she needed more support than she was getting from the school administration and staff.

James

James is an Hispanic male who recently graduated from a local college after taking some time off between high school and college. He majored in education with a concentration in theater at the elementary school level. He chose a concentration in theater to keep his options open as his route to teaching came after a brief stint as an aspiring actor. As a second-year teacher, James was aware that the original request for participants for the study was to first-year teachers. Because of the difficulty in finding participants, I decided to include second-year teachers as well. He teaches third grade at a small urban elementary school. James described the school as a "school with plenty of organized structure [where] a positive tone can be felt throughout the building" (James's Participant History Survey, January 2007). He also states that his school is considered "one of the model schools for the region." The school has a largely Hispanic population

with African American students comprising most of the rest of the student population. The student population of the school is 70 percent Hispanic and 25 percent Black, although James stated that he thinks that the demographics of the school are "90 percent Hispanic and 5 percent African American and 1 percent white and whatever is left is made up of other countries" (Group Meeting, 3/1/07). There are more than 100 students in the third grade and about 65 percent of the students at this school score three or four on the New York State mathematics test (2004-2005 DOE Annual school report). The school is in a new building with very colorful walls throughout. As James described the school, he stated that there is a large demand to meet the requirements of the district: updated bulletin boards every month, portfolios, checklists submitted, and other types of accountability documentation. The students in James's class, on average, were strong academically; he stated that they were "the top class" and also very motivated. James had approximately twenty-five students in his class, in a classroom that seemed a bit cramped.

The stability of the job and his professed love for children led him to the profession of teaching. Having student taught at a local elementary school, James thought he would be teaching there after graduation, but because his certificate did not arrive in time, the principal would not hire him. Two weeks before school started, James walked around to schools in the same area with résumé in hand and was offered a job as a walk-in at his current school. He is pleased with how it all worked out. At the time of the study, James had initial certification to teach in the schools and needed to obtain his master's degree within five years. He is pursuing a master's degree in childhood education with a specialization in mathematics.

Julia

Julia, a white female, is also a recent college graduate. She graduated from a small liberal arts college in the Midwest majoring in public relations and theology. She is in her first year of teaching at a large urban elementary school in an immigrant community. Over three quarters of the student population at her school is Hispanic or Asian and 15 percent are recent immigrants, (recent meaning that the children are immigrants or their parents are). Being recent immigrants, many of her students "started off in bilingual classes and moved on from there." Julia describes the school as having a "strong population of Muslims who attend the school and live nearby" (Julia's Participant History Survey, November 2006). This school is considered more stable than many other schools in the area because there is not much teacher/administrator turnover. She considers it to be a pretty good school, there are seven fifth grade classes, and she says that she has the "top" class. Julia teaches fifth grade to high-tracked students, and they are a highly motivated group of students. There were twenty-five students in her class at the beginning of the school year, but after March, she received three new students when another teacher left the school. Most of the students in her class have scored 3 or 4 on the New York State assessments in both mathematics and reading. This school is in an old, large five-story building without an elevator. Julia teaches on the fifth floor, and, as a result of the changes in March, she switched from one room to another room.

Julia came to teach at her school through a connection that she made with her summer teaching placement as a New York City Teaching Fellow. She stated that she never actually had any desire to be a teacher, though she knew that she wanted to work in a "profession of service." Julia's religious faith played an important part in her decision

to go into teaching. Her interest in mathematics made her want to teach high school mathematics but, because of her limited undergraduate mathematics experience, she did not fit the requirements and found elementary school mathematics to be her only option, since she did not want to teach in a special education program. Julia found the New York City Teaching Fellows Program as a way to fulfill her desire to teach in the inner city as well as to be close to her parents' home in the suburbs of New York City. In addition, Julia commented on how the Fellows Program offered a more competitive salary than other alternative certification teaching programs that she investigated.

Julia is a very enthusiastic person, and when she talks about teaching mathematics, you can see the enthusiasm on her face. "Just as when I was a student, I love math! I love teaching it, and when I do a lesson I really feel like I understand it better. I love explaining things to kids so they understand it" (Julia's Participant History Survey, December 2007). One of her initial struggles was that she had many students who wanted to finish fast and she wondered how to keep them academically motivated while not letting other students who need some help slip through the cracks. This concern of hers is supported by how she sees mathematics: "Math is a process of exploration and requires active engagement and carefully planned discovery" (e-mail correspondence, 5/30/07). However, this statement conflicts with other statements Julia has made about teaching mathematics, especially with the *Everyday Mathematics* (2004). This curriculum "focuses on what students need to know and the processes and skills necessary to reason, solve problems, and think critically" (Department of Mathematics statement, http://schools.nyc.gov/academics/mathematics/default.htm). Julia stated that at the beginning of the year she followed the curriculum very strictly but next year, "I

don't think I am going to do all of these lessons … and I will do more drills" (Group Meeting 4, 5/29/07).

Researcher

It is important to emphasize that I was a participant in this study as well. I began the study defining myself as a participant observer but later clarified my role as a mentor and guide.

I am a white female who has taught mathematics for more than twelve years. I graduated from a small liberal arts college in the Northeast, majoring in mathematics. I began my teaching career immediately after graduating from college. Because I had not taken any education courses and was not certified to teach in public schools, my only option was to teach in a private school. My first teaching position was at a small co-ed private school in New York City. I taught mathematics to students in third grade to eleventh grade. At this school, teachers were pretty much left to their own devices, but I began to ask questions, share resources, and observe other teachers to further my own education as a mathematics teacher. My second teaching position took me to a small, single-sex private school. At this school, I taught elementary-, middle-, and secondary-school mathematics, and AP calculus. This school was much more regimented about what was to be taught to the students than the previous school in which I had worked. When I entered the school, after having previous teaching experience, it took me a year to propose changes in the mathematics curriculum. To continue my own education as a mathematics professional and as an educator, I pursued my master's degree in mathematics at a local university. Since I was still teaching full time, I decided to take not only pure mathematics courses but also some mathematics education courses.

As I stated in the section on "Why this is of interest to me," my experience in teaching mathematics at all school levels, working with fellow teachers on mathematics curriculum and instruction, and my own connections with mathematics over the years led me to create this community of teachers. Initially, I wanted this work to improve the mathematics teaching of new teachers at the elementary school level as well as to have the teachers identify more as mathematics teachers. However, over the course of the year, I became more of a mentor and as a result, more concerned with their staying in the profession and taking ownership of the mathematics decisions in their teaching as opposed to teaching directly from the mapped-out curriculum.

The Work of the Community

The community of practice group meetings met approximately once a month. It was agreed that each teacher would have at least two observations before each group meeting. By the end of the study, each teacher was observed about nine or ten times. The group met at the City University of New York Graduate Center and the meetings occurred in the late afternoon. The teachers were supplied with snacks and drinks. What follows is a brief synopsis of each of the meetings.

Meeting 1, 3/1/07. This meeting began with an activity based on introductions. We started with a postcard activity in which the participants were instructed to choose two postcards from a pile of cards with a variety of different photos, one that shows how you feel about mathematics and one that shows how you see mathematics teachers. The postcards were used as a way to start the conversation. Here are some comments from the meeting regarding how the participants see mathematics: Jessica – "mathematics is

black and white, I see it as the one constant." James referred to his understanding of math as "the universal language," and Julia saw mathematics as exciting and energetic, "it is exciting to get the right answer" (Group Meeting 3/1/07).

After that three video clips were shown. As this was the first meeting, I chose the clips as a way to introduce some mathematical content. Julia's clip dealt with a lesson on integers, Jessica's clip dealt with a lesson on parallel lines, and James's clip dealt with a lesson on fraction word problems. After the discussion of the clips the participants were asked to do a short writing assignment (free-write) on "what is a mathematics teacher? And what is the mathematics teacher's role?" Many of the following views are somewhat consistent with what researchers have found in that teachers see mathematics as "a linearly ordered, fixed body of knowledge that is best learned by memorizing facts, rules and formulas and procedures for applying them to textbook exercises" (Wilcox, Lanier, Schram, and Lappan, 1992, p. 1) and see the role of mathematics teachers as conveying the knowledge determined by some curriculum (Feiman-Nemser, 2001; Warfield et al., 2005).

According to the teachers participating in the study,

> A mathematics teacher is an educator who teaches math. We have to give children the opportunity to see how math fits into their everyday lives. We have to expose them to different methods and strategies and provide students with a means to be successful. (James, free-write 3/1/07)

> Math teachers are responsible for relaying mathematical information to their students and mak[ing] sure that they not only understand it but that they can apply it. (Jessica, free-write 3/1/07)

> A mathematics teacher teaches math, very simply. If the math is not learned, the math teacher did not do their [sic] job. There is also an important distinction between simply a math teacher, and a good math teacher. (Julia, free-write 3/1/07)

Julia also wrote later that

> A math teacher can teach other things and subjects and may not exclusively be a math teacher. I think a math teacher should find math exciting and a continuous learning process. Math is a process of exploration and requires active engagement and carefully planned discovery. (E-mail Correspondence, 5/29/07)

My initial reflection on the meeting was that I felt that "they were a bit 'disturbed' by the fact that I have never taught in the public schools" (researcher's reflection, 3/1/07). As a result, I felt a need to discuss my qualifications to do this research and help the participants. By citing my experience of interning at the Department of Education during professional development of math coaches in *Everyday Mathematics* and other mathematics professional development with which I was involved with, the participants seemed to be more comfortable with my experience and qualifications.

I wrote in my journal that I thought the video clip section went well, "[the participants] tended to compliment each other." I was obviously concerned about the

content of the discussions because I commented on the fact that the teachers participating in the study did not ask any mathematics content questions. After some later reflection, I concluded that this might have been because of my input into the conversation: "I think that I talked too much." I wrote that the discussions about what is a mathematics teacher were very concrete, which was in contrast to the other discussions during the meeting.

Meeting 2, 3/29/07. This meeting began with a discussion of the National Council for Teachers of Mathematics (NCTM). I had just returned from the annual conference and wanted to share this resource (including the journals published by the Council) with the participants. They all seemed to be familiar with the organization, but none of them was a member. I encouraged them to become members as students. Julia stated that she was familiar with the publications and that she had to read an article for one of her graduate mathematics classes about how fractions are taught wrong in the United States compared to the way they are taught in Japan. "Fractions are a big problem, it was about why Americans teach fractions wrong and why the Japanese teach fractions correctly." James was very interested, responding with "let us know what it is"; Julia unfortunately said, "I forget." By the end of the school year, all of the participants had become members of NCTM.

I also wanted to share with them one session that I went to on how to use literature to enhance a mathematics lesson. I shared a bibliography of books suggested at the session. James and Julia were familiar with some of the literature.

Julia: I have a bunch of these in my class.

Me: Sometimes they just need to hear a story …Well, I mean it depends on the story and stuff like that.

(James nods his head vigorously, looking at Jessica, who is also nodding her head).

Julia: I definitely see how it is valuable.

James: *Two of Everything*[5] *[Hong, 1993]* is a good book.

Jessica: Uh-huh,

James to Jessica: "You have that book?"

Jessica: Yeah.

Julia mentioned a book on origami and James suggested starting to read a story and having the students finish it with a mathematical story. He used the example of a story entitled *One Grain of Rice*[6] *(Demi, 1997)*, in which the students have to write their own ending, predicting what is going to happen as the story progresses. I found this suggestion very helpful and the video shows the participants writing information down in their notebooks. This dialogue is an example of how the teachers are aware of their resources but would benefit from the opportunity to share ideas with others.

What followed was viewing three video clips from the teachers' observed classes. Discussions with the participants about what possible clips to choose for the meeting happened after the observation or over e-mail. Here is an example of the reasons a clip may have been chosen. Jessica mentioned in an e-mail correspondence (3/27/07) that she chose her clip because "I just feel like this one was not as drawn out [as the follow-up lesson] and [it] had many more moments where I was really teaching." Jessica's

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[5] *Two of Everything* is a Chinese folk tale about a husband and wife who discover a magic clay pot that doubles anything that is put into it.

[6] *One Grain of Rice* is an Indian folk tale about a raja who hoards all of the rice in his kingdom until a clever girl, Rani, who outsmarts the Raja when he offers her a reward. Rani asks for one grain of rice, doubled each day for 30 days.

comparison was between two lessons dealing with the similar topic of using parentheses with number models. In the first lesson on 3/12/07, Jessica introduced her students to word sentences using addition and subtraction with parentheses. This lesson followed the *Everyday Mathematics* (2004) text very closely and, as Jessica mentioned in her e-mail message, gave her opportunities for teachable moments or what I would refer to as a more teacher-centered approach. In the second lesson on 3/14/07, the students were asked to fill in a workbook page. The overall premise of this workbook page was to determine how many different ways and in what ways to score 10 points in a basketball game using 3, 2, and 1-point baskets. The students in the class seemed to understand the mathematics behind the activity and were able to explain many possible ways to come up with 10 points, but when asked to fill in the chart they became confused. Jessica believed that she spent much more time in class explaining what was to go in each column for the table than in discussing the mathematics.

Other clips may have been chosen for other reasons. After reviewing the clips myself, I sometimes suggested things during the group meetings for the participants to keep in mind while viewing the clips. For example, at this meeting I asked them to consider the curriculum, so our discussion could focus on the teaching in relation to the curriculum. At this meeting Jessica's clip dealt with number models with parentheses, Julia's clip dealt with the volume of rectangular prisms, and James's clip was a lesson on parallel and intersecting lines.

The overall reasons I found the clips relevant to the research was the connection that they had to the *Everyday Mathematics* (2004) curriculum. In Jessica's clip, part of it showed how she varied the lesson slightly from the book. In Julia's clip, she did not

deviate from using the workbook page in a very traditional way stating, "Do the work/here are the answers." She successfully used pattern blocks, but it was suggested that she let the students have a bit more hands-on with them as opposed to holding them up for the students to see. The curriculum suggested a much more hands-on approach. For James's clip, his instructions for using a ruler to create two parallel lines came directly from the *Everyday Mathematics* (2004) curriculum. It may have been helpful to the students to ask them how they would create parallel lines. James's lesson on parallel lines consisted of an activity in which the students were standing up with strings demonstrating intersecting lines and parallel lines. This specific activity was discussed in the meeting in addition to the clip that was shown with the ruler construction. During the string activity, he asked four students up to the front of the class to hold the ends of two strings and first create intersecting lines. These instructions were the only instructions he gave the students. This is a good activity that comes from the text, but many teachers overlook it. For example, when Jessica was teaching the same lesson she did not do this activity.

Following the discussion of the clips, we looked at some lessons from *Everyday Mathematics* (2004) and how to make adjustments. Two of the lessons were on non-traditional algorithms, the partial sum algorithm and the trade first algorithm, from the third grade curriculum. Another lesson was on exploring angle measures using a protractor from the fifth grade curriculum. I chose these lessons mainly so that the participants could see the progression of learning the students had been through or would go through from third grade to fifth grade. The discussion that transpired dealt more with the use of non-traditional algorithms.

The final activity of the meeting was to write a paragraph about "if you had the freedom to write a lesson on measurement in relation to distance, what would you stress and why would you stress it?" Some of the interesting comments from these writings follow:

> I would stress the importance of the standard unit of measurement. In this case, I agree with the *Everyday Mathematics* approach of showing students what is the problem with using non-standard units such as a foot and a hand to measure distance. I would like to only focus on the metric system, only because it's easier to change between smaller and larger units. (James's writing 3/29/07)

> I would insert the idea that we may not always be able to see the distance we are measuring (i.e., distance between two states, distance between the earth and the sun) and I think that this would help with choosing proper/appropriate units of measure. (Jessica's writing 3/29/07)

> I would want my students to understand that distance is the total length from start to finish. I would start by discussing distance on a straight line. I might use something movable, like a piece of yarn, to show that the total distance doesn't have to be in a straight line. I might even do a [calisthenics] activity, having students count steps that they take and end up where they started. (Julia's writing 3/29/07)

Some interesting dynamics of the participants began to develop in this second group meeting. James being a second-year teacher seemed to have a bit more comfort talking about his experiences in the class and tended to take a more authoritative position on topics related to teaching. For example, when discussing Jessica's clip and the teaching of modeling with multiplication and the basketball math journal page, he began to explain exactly how he went about teaching the lesson. The fact that during his first year of teaching, the topic went over his students' heads and as a result, he taught it in a much more systematic way during the year of this study.

Initially, I reflected that a transformation was occurring among the participants; they "already appear to have some common practice and a basis from which to talk" (researcher's reflection, 3/29/07). Another aspect of their teaching that came to my attention after this group meeting was that there are a lot of areas in which the teachers do have freedom in their classroom, but, as Julia expresses it, the teachers do appreciate the structure that *Everyday Mathematics* (2004) gives. The differences between the way that Jessica chose to teach the parallel line-intersecting lines unit as opposed to the way James taught the same lesson, can possibly be attributed to who these participants are as teachers.

Meeting 3, 5/10/07. We started this meeting with some mathematics. I introduced the other participants to a game entitled, "Petals Around the Rose"[7] which I

[7] *Petals Around the Rose* is a dice game with no known origin. The "master" of the game rolls 5 dice and states "The name of the game is petals around the rose, the name is very important." Once the five dice are rolled, the "master" states a number that he/she has determined from the dice. The object of the game is for each player to figure out the "rules" of the game or determine how the "master" determined a number/answer from the dice.

have used for years in my teaching. I chose this game because it is a great activity to do with children and it is a game that gets students to think "outside of the box."

After we played this game for five minutes, we stopped and began to work on a "problem of the week." This problem was introduced as one that could be used for students across many grades because of the variety of techniques that could be employed to solve the problem. I chose both of the "Petals Around the Rose" game and the problem of the week to see how the participants interacted with mathematics as well as what transpired when they discussed mathematics and problem solving.

Following the game, the participants watched three video clips. Once again, these video clips were chosen based on suggestions from the participants. Jessica wanted a clip that showed the use of chips to discuss fractional parts, James liked his lesson on having students use mental mathematics to do multiplication, and Julia wanted the clip that showed her class working with manipulatives in exploring three-dimensional shapes. She explained during the group meeting more specifically why she chose the clip.

> I chose it for three reasons. One, I liked the part where I was explaining the tuna fish can thing, because I thought that that was a really good connection to make. Two, I thought it was interesting watching the kids play "give me the ball, give me the ball, give me the ball," how they reacted to the manipulatives because they don't do it a lot and I felt like it was a nightmare [nervous laughter]. The third reason is that I thought it was hysterical when [laughing] Greg was singing to the camera and then he found Michael and they're just like I am just watching this is my apartment it was like unreal. (Julia, Group Meeting 3, 5/10/07)

Commentary by the participants about their video clips was very complimentary, but they did start talking about student learning and understanding.

James: He just knew it was 48 he was like, "I just know it is 48" but it was like out of all the numbers to pick how did you know to pick 48?

Me: He probably had forty in his head and started counting up because he could see forty.

James: He has a good number sense.

Me: Right, he has good number sense but he couldn't communicate how he got his answer.

Julia: They might not even know that if they used estimation that estimation is what they did.

I drew this conversation to a close because, as I wrote in my reflection, "it looked as if Jessica was getting bored and I want to get her more involved; she had to leave early today." It is possible that I moved to another topic to get more involvement from everyone.

After watching the clips, we began to talk about interruptions in their classrooms, be it from announcements, other teachers, or students. The teachers did not want to get into a conversation on this; it did not seem to faze them ("it is part of the job"). We also touched on discipline issues; again, the teachers realized or were resigned to the fact that this was part of the job. In this instance the prompt for this discussion did not produce a productive conversation.

The final part of the meeting was to discuss math coaches. I asked them to respond in writing to the following question: "How and in what ways, if any, is your

math coach helpful and what is it about the program that you would change?" It was very telling, as I wrote in my reflections. They commented at length on the benefits of having help or someone to bounce off ideas.

The final few minutes of the meeting went back to playing "Petals Around the Rose." Jessica had to leave early, so she wanted to know the rules of the game and how it was played before she left. Julia and I continued to play the game with James until the end of the meeting.

James: It is always an even number.

Me: Good observation, let's write it down.

James: The answer is two. (We waited a bit and Julia said the answer was four.)

James: It definitely has nothing to do with the sum of the dice, it has to do with how many times…

We discussed how to work with students so that they would not get frustrated. James did not want to stop playing and wanted to figure it out. He did not want to be told how to "play the game" and it was only through e-mail two weeks later that he figured it out.

My initial reflections on this meeting are as follows: Jessica seemed to work on the problems in a manner similar to how her students worked on the problems. She was quick to give up and also seemed to want an easy solution. James and Julia solved the problem almost immediately as if it were a race. It is interesting how the teachers' behaviors about mathematics were similar to those of the majority of the students in their classes. In relation to the commentary regarding the clips, the participants gave no real constructive criticism. "It would be nice to see something that was done wrong in a clip to see what the participants would say" (My Reflection, 5/13/07).

Meeting 4, 5/29/07. This meeting began with a discussion of the pacing calendars for the fifth grade and the third grade in relation to the *Everyday Mathematics* (2004) curriculum. Some discussion questions were: How do you feel about the pacing calendars? Do they make sense in relation to the lessons that you taught this year? What pressures may influence the choices that are made in your classroom or in your school? Julia commented that she thought each row of the pacing calendar stood for one day. She had moved her class along very quickly as a way to keep the students involved and motivated. Now, at the end of the year, she is going slowly because she is at the end of the curriculum. James made a comment about how his math coach and math specialist reconfigured the pacing calendar, but as a result he feels that it did not work so well to break it up as pre-March and post-March. This was the first discussion where the participants took a closer look at what they did in the classroom in relation to what was outlined in the curriculum.

Then we viewed the clips. At this session, the participants and I picked random clips. Either I suggested a clip by writing in an e-mail, "What do you think of a clip from the discussion of the math message on mental math problems" (E-mail Correspondence with Jessica, 5/24/07) or they mentioned in the informal interview, "we can use a clip from this lesson but don't show the chaotic parts" (Informal Conversation with Julia, 5/23/07). The three clips that were shown covered topics such as reviewing sources of error in measuring volume and capacity, using estimation to determine the possible answer to a multiplication problem, and working on reading, writing, and understanding a decimal representation in relation to money. I asked them to pay particular attention to

students, curriculum, classroom, and the teacher and then to make some constructive criticism and suggestions.

The comments were very good, but they mainly avoided any mathematics content discussions unless I raised the topic. Their critiques were primarily about the pedagogy. For example, Julia made a comment with regard to her teaching of the volume formula for a cylinder and stated, "When I was explaining the formula, I should have used the visual more, instead of just pointing to the board" (Group Meeting 4, 5/29/07). James was very discouraged by the teaching that was shown in his clip and immediately when the clip had been shown, said that he should not have spent so much time on the topic.

Then we talked about the research project, since it was our last meeting. Conversation focused on whether what was learned from the research project could be transferred to their schools and how, if at all, the participants thought their colleagues would respond to establishing a community of practice. The discussion was very positive about the experience that the participants had just been a part of but also realistic, in that they recognized the difficulty of extending this type of professional development to their schools.

Finally, the participants were asked to respond in writing to the question, "What do you like about being part of this research project? What do you dislike?" Some responses were interesting because of the enthusiasm they revealed about being a part of the study. The participants also made comments about what they would take from being part of the study.

> I thought that [being part of this research project] would be a passive experience, but I can't emphasize how crucial the consistent feedback from a veteran math

> teacher and colleague has really helped to develop me into an effective teacher. I now know what questions to ask myself and what to think about as I am developing my lessons. (Julia's Response, 5/29/07)

> It has challenged me to be a better math teacher and teacher in general. ... I like that I can gain input from people outside of my work environment but people who share similar experiences. (Jessica's Response, 5/29/07)

> I felt I've met an educator who I can turn to after this study for extra guidance. I thought being filmed and having the footage to keep forever is an invaluable tool. I have grown as a math teacher by reflecting on my practice and that of others. (James's Response, 5/29/07)

Ownership of Curriculum

Having taught mathematics for at most a year-and-a-half at the time this study was conducted, these participants were enthusiastic about their teaching of mathematics. Among the many resources at their disposal for teaching mathematics was the curriculum. For these participants, that meant using the adopted curriculum of *Everyday Mathematics (2004)*. Similar to Stein, Silver and Smith's (1998) work that states that productive professional development lies with the intent of the participants in teaching and learning reform mathematics, these participants had the shared vision of learning how better to teach mathematics.

These participants initially worked with the standardized curriculum in their classrooms as a tool given to them by the school community and as a part of the rules of their teaching. In relating the participants' ownership of the curriculum to Cultural Historical Activity Theory (CHAT), it can be seen that in the school community this tool was not yet seen entirely as one that would help the teachers reach the goal of teaching their students mathematics. There was no real interaction with it; they had not developed the knowledge and awareness of the curriculum in order to give them the ability to change or the agency (Sewell, 1992). If the teacher's manual said to work on a specific workbook page, they did. As the study progressed, the participants began to use this tool in relation to the learning of their students. For example, James would initially say, "do journal, p. 214," but after discussing the reasoning behind and application of the journal pages, James chose appropriate problems for the children to complete instead of asking them to do an entire page. Jessica stated that she was always comfortable modifying the math message to suit her class, the students, or what was being taught. Before she taught the lesson on number models with parentheses, Jessica recognized that the math message for that unit "would have been a lesson in itself. It is more of a literacy lesson" (Group Meeting 2, 3/29/07). This is one instance where she made a modification, but she was consistently dependent on the "whole class discussion" part of the curriculum and the prescribed workbook pages. It was not until post-March, when she revisited working with fractions, that she began to deviate from the text. After her lesson on April 17, 2007, I commented, "I feel that Jessica is too dependent on the *Everyday Mathematics* resources and not on using her students' knowledge to determine what or how to teach" (Post-observation Reflection, 4/17/07). After our informal interview, she modified a

follow-up lesson, where she stated, "I wanted them to have a more engaged way of doing fractions using the counters and I really wanted to emphasize the groups" (Group Meeting, 5/10/07).

It was difficult for Julia to make adjustments in her teaching. She followed the *Everyday Mathematics* (2004) curriculum but tended to move quickly through the material. Julia stated that it was difficult to teach students who "already knew it" because she wanted to keep them motivated and interested in what was going on in class. In the May 7 Post-observation Reflection, I wrote that "Julia appears to be too dependent on curriculum and it takes away from her own thoughts and knowledge about the subject – the children can't see her thinking 'let's try something new.'" Julia's variation from the *Everyday Mathematics* (2004) curriculum tended to have to do more with the time spent planning or her own knowledge: "It was a lesson that, if I had prepared more than 24 hours in advance I would have been able to use better manipulatives and visuals…" (Reflection, 3/9/07); "When I reviewed the teacher's manual, I found it to be confusing," (Reflection, 4/17/07). She recognized the benefits of this tool: "There are usually a lot of great resources in *Everyday Math*, and I don't always take advantage of them" (Reflection, 1/23/07).

The participants both praised and critiqued the curriculum. This curriculum resource had been created not only to encourage a strong conceptual understanding of mathematics, but also to help students become fluent in computation (NCTM, 2000; UCSMP, 2005). This balance was hard to come to terms with for the participants in relation to traditional forms of teaching mathematics, such as algorithms, with which they are familiar. Julia expressed some varying opinions about the curriculum.

> I have mixed feelings about *Everyday Math*. The structure of it is very helpful with planning, as a 1st year teacher, but some of the things don't make much sense. For example, I have the top class and they all pretty much know how [to] multiply 2-digit numbers, but according to EM, they had to learn 3 or 4 methods of this. Most of the kids were bored and jaded and wanted to learn something new. I think if anything, this is helpful to 1 or 2 students who struggle with math, but most need more of a challenge. (Julia, E-mail Correspondence 1/24/07)

There are instances where the participants began to take ownership of the curriculum and began to amend it to suit their situation in the class or their students. When James was teaching equivalent fractions, he saw that *Everyday Mathematics (2004)* has fraction strips that need to be cut out from a template. The strips are difficult to work with and could be difficult to cut out. James decided to use sentence strips that are pre-cut pieces of paper with 1 -1/2 " guide lines ruling with 3/4" dotted midline on one side and have dimensions of Width: 24 in; Height: 3 in; and are larger than the ones from the text. He stated that he got the idea for using the writing strips from a mathematics professional development workshop (Reflection, 2/9/07). When Jessica was teaching partial products with the base 10 blocks, she began to deviate from the curriculum because the students were not grasping the material. Jessica had them solve the problem using the blocks, write down the numbers as they went, and write down an explanation of the solving process at the end. "I think that some of them started to see the connection. I wish I had thought about the connection before teaching the lesson – perhaps I could have approached it differently" (Reflection, 5/15/07). Information gathered from the informal interview supports Jessica's need in understanding the material before teaching it.

Jessica said that her math coach did not get an opportunity to photocopy the array sheets for the lesson, which might have had some effect on Jessica's and the children's understanding of the material (Reflection, 5/15/07).

James's discussion of his use of the curriculum when using number models with parentheses after observing a clip of Jessica teaching the same lesson, was an interesting example of how he has adjusted his teaching of an *Everyday Mathematics* (2004) lesson.

> I did it last year and it was a big mess. It was going way over their heads. I was getting upset, and they were getting upset, and we just ended up all doing it together. This year, I remember saying to myself, I am going to model a systematic approach from the beginning ... I mean it was still a struggle, but this year it was more manageable as opposed as [sic] last year, when it was way over their heads, it didn't flow right. There was a lot of guidance throughout it this year (Group Meeting 2, 3/29/07).

His focus on the adjustment was less on working with parentheses with addition and multiplication and more on recognizing patterns.

As the community of practice research was coming to a close and the participants' school year were ending, they began to take more ownership of what they wanted from the curriculum. This led to more independence in relation to mathematics based on their knowledge and beliefs as well as in relation to the practice of teaching mathematics (Boaler and Greeno, 2000; Van Zoest and Bohl, 2005; Warfield et al., 2005). Looking through the group meetings, I noted that their comments changed over the course of the study from "I got that from *Everyday Math*" (Julia, Group Meeting 2, 3/29/07) to "I also think it worked well that I didn't even use the math journal as part of the lesson" (Julia,

Reflection 5/9/07) to finally in the following school year: “Fractions seem to be going better, but that’s because I really pulled apart the unit and taught it my own way. Instead of teaching ordering fractions and decimals at the beginning, I waited until they understood how to go from fraction to decimal. The use of visuals has been very powerful” (Julia, E-mail Correspondence, 12/8/07).

Relationship and Interactions with Mentors/Coaches

An important part of being a new teacher in the New York City Public Schools is having access to a math coach and/or someone who is one’s mentor. Math coaches are part of the Children First reform initiative sponsored by the New York City Department of Education (http://www.nycenet.edu/Administration/Childrenfirst/CFAgenda.htm). In this initiative, math coaches in some form were supplied to every elementary school. Coaches were either solely the math coach for that specific school, the math/literacy coach for that school, or a math coach for several schools. This support program was rolled out to aid teachers in working with the new curriculum and facilitating instruction in relation to the new curriculum of *Everyday Mathematics* (2004) at the elementary school level and *Impact Math* by Glencoe-McGrawHill at the middle school level.

The participants all had math coaches and people who acted as their mentors with varying degrees of influence. Initially, in getting to know the participants, their comments, reflections, and references to mentoring and coaching were positive. As the study progressed, the participants began to make statements that showed a desire or need for more help, information, and guidance from this resource.

Julia stated in the beginning of the study that she had both a Department of Education (DoE) mentor and a university mentor. Her DoE mentor came once a week to observe her teaching. She found the mentor helpful in areas that needed improvement. Her DoE mentor was much more of a literacy coach, so many of her suggestions were not related to Julia's mathematics teaching. Julia mentioned that her university mentor came "less frequently" and throughout the course of the study she did not mention this mentor again.

Julia stated in her Participant History Survey that her math coach helps her by questioning her style and suggesting both how to work with struggling students and ways to enrich curriculum for students who are more advanced (December 2007). Julia believed that as the year progressed she received less help from her math coach because her students were doing well in mathematics. Again, Julia stated that for these "advanced" students, her math coach was very helpful in giving her additional sheets for the students to do (Reflection, 2/6/07). Even with this form of support, Julia stated, at one point in Group Meeting 2 (3/29/07), that her coach left her alone because he perceived her to be doing a good job. And later on, Julia made this comment about her math coach: "Because of the size of the school, I can't always track my math coach down when I need her. … All in all, she's very helpful and a great resource" (Group Meeting 3, 5/10/07). Julia's varying views regarding her math coach seemed to depend on her need for help, advice, or supplies.

> The math coach is helpful – when I say I need this, she gets me what I need, but I actually have to seek it out. She knows I am doing fine since I'm not a problem, I don't get much attention. The day I was doing the lesson on capacity and volume,

> Laura was there when I was planning, and I happened to run down to my math coach and asked "Do you by any chance have a measuring cup" and she just happened to have one. (Group Meeting 2, 3/29/07)

This acknowledgment that she might want more interaction led her to write how it was "helpful to get consistent feedback [from this study] as opposed to the 'great job' that I was getting from my math coach or from the mandatory yearly principal's observation" (Group Meeting 4, 5/29/07).

Jessica's mentoring situation seemed less structured than Julia's. Her university mentor came once a month and discussed the observation sometimes three weeks later. Jessica stated in an informal interview that she doesn't really care for her university mentor but having a mentor provides three credits toward her master's degree (Informal Interview, 3/12/07). Although, her DoE mentor met with her on a "consistent basis," very rarely was the support related to mathematics. Jessica stated that she appreciated the support and the help in facilitating lessons (Participant History Survey, January 2007). She commented on a couple of occasions about the ideas and suggestions that she gathered from her university course.

Jessica's math coach came in on a consistent basis "my math coach comes in a lot. I have kids who are slow in math. We go very slowly" (Group Meeting 3, 5/10/07). The students are excited when she comes into the class, because, Jessica stated, the students have a good relationship with the math coach and they liked getting individualized help. "Initially, she helped me set up my lessons and gave pointers while she watched me teach. She also modeled and still models lessons in my classroom" (Group Meeting 3, 5/10/07). The math coach also helped Jessica plan and pace her

lessons. This positive view of her math coach did not prevent Jessica from making some suggestions of additional help that she would appreciate having. This help would be in the form of providing and/or determining forms of remedial work or enrichment work for her students based on reviewing assessments. Aside from this critique, Jessica repeated that she finds her math coach to be a big support.

James stated that his math coach was extremely helpful. In his school he has both a math coach and a math staff developer. His school provides the teachers with a monthly pacing calendar that has been modified slightly from the Department of Education's version. This modification was made before the beginning of the school year, with some input from the teachers. James appreciated the support he got from both his math coach and his math staff developer. The staff developer supplied each teacher with class sets of the mathematics masters for the unit in addition to the required test prep books. One thing that he mentioned was how supplies are readily available to the teachers and for him it is even better because there is a resource area for mathematics right near his classroom. James would have liked more direction on how to work with students' weaknesses in mathematics and would have liked more work on differentiated instruction (Reflection, 5/10/07).

Some of the issues surrounding a math coach or mentor are based on the over-arching structures and policies of the school. Going back to James's supportive environment, he stated that even though it was helpful in many ways, it was overly structured. In April, the mathematics department ordered the teachers to give a mid-year assessment on Monday and Tuesday. To accommodate this request, the department also gave the teachers resources to review for the assessment. James still wanted some more

guidance and when he went to his math coach, he reported back that he got the typical answer: "As the teacher, I trust you'll do what's best for your class. You know them best" (E-mail Correspondence April 20, 2007). James was very discouraged and proceeded to ask for my help in how to prepare for the assessment.

In Group Meeting 3 (5/10/07), the participants' responses to a prompt to write about math coaches and to suggest something that could be changed, reflected what they felt they needed. For James, his response was even more telling because he hopes to be a math coach one day. He stated that he would appreciate it if the math coach would "do more of a breakdown of students' weaknesses, to help teachers focus on math small instruction." This comment refers to his need for more information on differentiated instruction.

The benefits of mentoring and the math coaches for a new teacher depend on the mentor/math coach and the teachers who are being helped. As I stated earlier, Julia's interaction with both her coach and her mentor were variable throughout the school year. She thought she was getting what she needed from them until she became a part of this project.

> I never realized how helpful it is to get the feedback, from the lessons. After you left on Monday and I got all that feedback it was like gold for me. I think a lot of people are resistant to having people come and observe because of the pressure, but for me, I will take as much as I can get.… Ideally, I think it would be nice for a first-year teacher to get feedback on what she should change and what she needs help with. (Group Meeting 3, 5/10/07)

New Teachers

New teachers are continually entering and leaving the New York City Public Schools. One of the reasons for undertaking this study was to see whether this type of a community of practice had any merit in helping new teachers stay in the profession longer. With this question in mind, I noticed that these participants have some connection to teaching that can be described as being a new teacher. What follows in this section is a look at a conversation that gives a brief look at the challenges that new teachers face in the New York City public schools. Certain comments during the group meetings seem to be evidence of how each of these participants has resigned himself/herself to the difficulties that are inherent in the schools and, as a result, teaching.

After the participants had introduced themselves and the schools at which they are teaching, I introduced myself and set forth what I hoped we would all get from being part of this study. What I am now describing is a vignette that began a half an hour into our first meeting. This vignette exemplifies the feelings that these teachers have about being new teachers, about working in the schools, and even about their relationship with veteran teachers.

James: I have a question, why did you choose to have it with first year teachers?

Me: I remember being a first-year teacher and I remember how difficult it was, and because a majority of the teachers in the public schools are new teachers.

(Laughter from Julia and James, Jessica smiles)

Julia: That's true.

James: They don't last too long these days, do they?

Me: That was the main reason, the policies that are happening right now are trying to get teachers in right away. And you know, teachers are leaving after three, five years.

James: Three to five years.

Me: So I figured, what is happening in their first and second year that's really affecting this, people not staying in teaching.

Julia: Yeah.

James: I think teachers just burn out faster these days, because before that we used to see teachers, they were teaching for fifteen or twenty years. When I was going to school, you would always see older teachers and now all you see is us young teachers; I think it has to do with that, with burn out because of the accountability factor.

Me: So, what is making us burn out?

James: More work. (Jessica and Julia respond with laughter and "yeah.")

Jessica: I think it is the policies that have been put into place. Especially, after talking to older teachers and veteran teachers who have been in my school for twenty-five years. They say you know if they came in at this point where I was coming in, they can't see themselves staying for twenty-five years as opposed to when they…

Me: The other thing is that when we were kids our teachers, most of the teachers went through traditional education programs and went through and did student teaching. That has also changed a lot.

(talking to James): You did some student teaching in your undergrad?

James: I did it for a year (nodding).

Me: Okay, some of the schools are providing a lot more student teaching, which is really good. But a lot of teachers are coming in without any student teaching, or any mentoring experience before that and so the traditionally certified teachers already had that support before they started, which might make burn out less common.

Julia: Well, and that's the thing too, I mean you know with the fellows program and that whole thing, I've had this discussion before. A lot of people enter it because they want to teach because they don't know what else to do and yeah there are also people who want to teach.

I am going to highlight and expand on certain aspects of this vignette in relation to each of the participants.

James's comment about "burn out" is an example of his feeling that the profession of teaching requires a lot of work. He feels that there are too many things that need to be done in order to meet accountability requirements. Of the things that James referred to during reflections and group meetings, usually with some sort of exasperation, were reports, after-school help, bulletin boards, being a pit stop for students from other classes, schedule adjustments (library closings), and inflexible standards. In certain instances throughout the group meetings, James would refer to the part of being a teacher that is "just part of our job." He is aware of all the challenges that face new teachers, such as working with the curriculum, having to give assessments, dealing with interruptions, and managing the myriad accountability issues. He resigns himself to the fact that, it is something you "just got to deal with ... professionally" (Group Meeting 1,

3/1/07). However, even with this professed resignation, James sees education as a career for himself. He hopes to become a math coach in the future.

Julia appears to be frustrated with the New York City Teaching Fellows Program that she is a part of. The way she sees it, the program is really targeting people who think, "If you don't know what to do, why not teach?" Julia related this aspect of the program immediately to the difficulty of retaining teachers,

> If you don't really want to teach you're not going to want to stay with it, because you are fighting an uphill battle. There are so many things and even not just the policies, but I mean I find in my school, the department of education is extremely disorganized. (Julia, Group Meeting 1, 3/1/07)

Julia sees her involvement in this profession as a personal journey, a fulfillment of her desire, and a calling to work in a profession of service. During her college years, she developed a passion for issues of social justice and injustice, particularly in an urban setting. With this view of her own teaching, seeing people starting out as she is starting out within the "disorganization" of the system, is disconcerting to her.

Jessica is very much aware of the policies that affect her situation as a new teacher. She is actively involved in becoming a part of her school community by organizing and running a student after school club (step, a group dance). Unfortunately, halfway through the year, the administration said that there was no time for the students to meet. This was unfortunate for Jessica as she had made the effort to become involved in the community but was unable to follow through with her intent. Jessica expressed frustration with not knowing how to fix this problem as well as saying, "the principal wouldn't have done this if I was [sic] an established teacher" (Informal Interview,

3/12/07). In relation to her teaching, Jessica feels the constraints put on her in that she only has forty-minute blocks to teach math, she is supposed to give quizzes on certain days, and she is required to follow the pacing calendar faithfully (Group Meeting 2, 3/29/07; Reflection 4/17/07).

The Community of Practice

The basis for creating the community of practice/inquiry arose out of my years of teaching. For me, the collaborative approach to teaching was very beneficial in both my development as a mathematics teacher and as a teacher. The idea of community develops mainly from Wenger's (1998) work, in which participants are mutually engaged in working toward a common goal of improving their teaching of mathematics through involvement in a group. Looking at the clips and reflecting on their own teaching as well as the teaching of their peers in relation to content, pedagogy, curriculum, and other topics was a large part of the community of practice. The participants in this study said that they were interested in being involved in the study to improve both their teaching and their understanding of mathematics (Group Meeting 1, 3/1/07; Participant History Surveys for all participants). Using the video clips became a primary resource in the community of practice. As I stated in a group meeting reflection, "[the clips are] such a big part of what we are doing here because we are talking about our teaching." These clips led to further reflection on their own teaching of mathematics, mathematics, and teaching in general.

Looking at the change over the course of the four meetings, a pattern emerged from the coding (see Appendix C) that shows that the discussions dealt more with student

behavior and mathematical content in the last two meetings as opposed to policies. This was interesting because throughout the four meetings, we discussed curriculum, assessment, coaches, mentoring, and other school policies that influence their teaching. There are only three instances where comments were made regarding student behavior in the first two meetings as opposed to fourteen instances in the last two meetings; similarly, mathematical content comments increased from five to fifteen. Discussions that were coded for student behavior were any dialogue that dealt with management of students or the mathematics learning of students. Discussions that were coded for mathematical content were dialogues in which the participants mentioned such things as conceptual understanding or where they questioned specific topics. The change in emphasis of the discourse was even apparent to the participants, as was seen from Jessica's comment, "I found that I wasn't just looking at their teaching but also looking at the students; there was a balance between our concern for the students … the mathematical aspects of it as well. I don't know if there was much about our school except in the beginning, when we mentioned stuff like 'our school wants us to do this, or whatever'" (Group Meeting 4, 5/29/07). James agreed that he felt that the participants started to focus more on themselves rather than "outside factors."

A large benefit of the community of practice was that the teachers had an opportunity to look at the curriculum that they were using with fellow teachers and a "mentor." During Group Meeting 2, I presented the participants with the activity of looking at a couple of lessons that they had taught earlier in the year. In conjunction with the lessons, I also had available the pacing calendar and the Standards. Initially, while looking at the lessons on non-traditional algorithms, the participants began with

comments like "ugh, partial sum, it totally messes up kids who know how to do the algorithm" or "oh, don't get me started." As the discussion continued and they began to look at the text more closely, some of the comments showed a greater understanding of the thoughts behind the curriculum, pacing calendar, and the Standards.

Jessica: Now, that I look at this I think that it reinforces place value.

(the participants are all looking at the text, pacing calendar, and the Standards)

Jessica: Kids, I feel, still struggle with place value in March and so, I think it is interesting that they don't put it in…

James: But, it is one of the standards though, understanding the place value structure, see it is in line with the New York State standards. *(James is very fluent with the standards.)*

Jessica – "Yeah." *(I am not sure if she was aware of this before the discussion.)*

James: I agree with you, that it does reinforce place value, but I would not do the hundreds first, I would get them in the habit of doing the ones first so just how they are doing it here, I would have them start from this side. (*Pointing to a problem in the text.)*

Julia: I was just going to say that because that would alleviate the problem.

Jessica: And then that is how you add in real life.

James: Yeah, without regrouping this is adding without regrouping.

Jessica: Right, because does this apply when you regroup? It does, because say this was 3 and 7 it would just be 10 and 9 and 5 would be 14.

James: That is why the base ten blocks are good, because 13 tens what do I do with 13 tens I could use one flat and 3 tens, … regrouping without using the word regrouping. … I think it is a strong lesson I would just change it from right to left.

Me: Why, why would you change it from right to left?

James: So they won't develop any bad habits when they get into the real algorithm.

Me: do you expect them to do use this algorithm later on?

Jessica: Not really.

Me: Never?

James: I kind of want to get away from it.

Me: Why?

Jessica: I mean I think we are biased.

James: I think so.

Jessica: because of how we learned and how everybody learned until *Everyday Math*, so…

The discussion continued with my input about the benefit of using this partial sum algorithm for enforcing estimation. Toward the end of the conversation, the participants began to see that they actually used the partial sum algorithm informally especially in relation to estimation.

This example of what happened in the community of practice demonstrates the transforming views of the participants at the time of the discussion, but what is even more telling is what happened a month later for James and a couple of months later for Jessica and Julia.

> *Everyday Mathematics* is a good program and when you follow correctly, builds strong mathematical foundations for young math learners. I have to continue studying the program and myself to understand why it is that I do what I do. (Does that make sense?) Hopefully, this study will bring me closer to that realization. I had a great follow up to Friday's lesson today. I taught them the partial-products algorithm and to my surprise, many of the kids liked it. I understand what you meant when we discussed partial sum and partial products. Jessica, Julia, and I were all opposed to it but you noted how it's important for students' sense of estimation. I totally saw it today and unbelievably, I prefer this algorithm over all the other ones I have taught thus far. Also, it is the one we can truly do in our heads and used in real life, as opposed to the standard multiplication algorithm. (James's Reflection, 4/30/07)

A clip from James's lesson on partial products algorithm and mental math was shown at the third group meeting (5/10/07). After the showing of the clip, Jessica made the following comment: "I was looking at mental math because it is one of my next lessons. I was thinking about cutting it out because of [time], but now that I have seen it, I see how beneficial it is…and how it incorporates other skills."

Julia's relationship with non-traditional algorithms was less agreeable. In referring to a student working with lattice multiplication, I stated that it was nice to see Adrian successfully using lattice multiplication to solve the volume problems. Julia responded with a comment that reflected her surprise that students would deviate to the non-traditional algorithms but then added that these algorithms are great for some kids who "need another way to do the problem" (Informal Interview, 5/23/07). Over the

summer she took a mathematics course with other teaching fellows. She stated that "I found myself defending mathematics and why students need to prove why they get an answer, and why it's important to teach partial sums addition, etc." (E-mail Correspondence, 6/6/07). Summing it up, Julia commented that, at the beginning of her second year, she tried to teach her students the partial sums method for addition, and how it worked until she incorporated decimals. She felt that her students were starting to get confused

> I ended up scratching that and teaching them the traditional algorithm for adding decimals… but then again, I believe [the traditional] method has some validity because that's how I was taught, and it eventually clicked for me, just much later. (E-mail Correspondence, 9/30/07)

The other benefit of the community of practice is reflected in the positive feedback the participants gave about being a part of the study. James found it helpful in that it made him consistently think about his teaching and made him want to improve it. "Honestly, you put more effort into your teaching. If I did this when she is not here what can I do" or "What would Laura say about this?" Jessica stated that it made her think about her questioning more instead of asking, "Does everybody understand?" She asks students to explain their thinking more (Group Meeting 4, 5/29/07). Julia commented in an e-mail correspondence, "I'm really realizing how much better equipped I feel in regards to being a math teacher" (6/6/07).

These participants are engaged in the activity of the community, which leads them to reflection and thinking more about mathematics and their teaching of mathematics.

They may not necessarily change their teaching practice, but they are questioning their actions, mathematics, and the structures of the schools.

Difficulties and benefits of a community of practice or trying to create one. One would hope that involvement in this type of practice would lead teachers to support using it in their schools. During the final group meeting, it became apparent that at least with these participants it would not be possible to have a school-based community of practice. One of the difficulties that the participants stated was the issue of being a new teacher and coming into a school and announcing to the other faculty, "Let's get together and improve our practice of mathematics teaching." The teachers did not see this as their place in their school community. Julia stated that the teachers in her school would probably feel that they needed a leader in order for it not to turn into a "coffee clatch." Jessica agreed that having someone who is an outsider would be helpful in "questioning our thoughts."

These comments refer to their understanding of themselves as new teachers. James mentioned that there would probably need to be some incentive for teachers to get involved in a community of practice. Unlike the participants in this study, many teachers do not seek out extra help for mathematics teaching. James stated, "You have to have people who want to better themselves pedagogically. We are all serious about becoming better teachers." Furthermore, James stated that teachers "have to [have] some kind of incentive. They need to get paid or have a period release."

"Being involved in the study did require something from us in terms of reflections and meeting in the group meetings, so it's not necessarily a casual thing" (James, Group Meeting 4, 5/29/07). James seemed the most open to trying to organize some community

of teachers in his school. "I think that my principal would be all for it." Jessica, however, saw that she would not get similar support from her school administration. She believes, in order for something such as a community of teachers in her school to be established, that "something needs to be on the line. Expectations need to be established." She stated that she thinks teachers would "need to know that they are going to gain something from being part of this" (Group Meeting 4, 5/29/07).

My role in the community of practice. My role in this study was initially one of a participant observer and as a source of knowledge on teaching and mathematics in both the classroom and the community of practice. Soon after the study began, I became more of a mentor. Both in and out of the classroom, the participants used me as a sounding board and as a person to ask for suggestions concerning all aspects of their teaching. My mentorship role was made even more evident when I was at their schools; all three of them referred to me as their mentor to colleagues. What follows is an example of how the participants used me as an additional resource:

> James: The math department has ordered us to use this Thursday and Friday as review days for whatever we feel the students need to go over for the mid-year exam… I am not sure how I'm going to do this. I'm thinking [of] looking back at all the assessments and seeing which were the problem areas for the majority of my class and starting there. I will gladly take any suggestions you have as well…
>
> Me: Regarding your plan for Friday and reviewing for the assessment: If the students know about the assessment, I would ask them to look in the Math Step workbook[8] for an example problem that they find difficult; they can do this in

[8] A mathematics workbook published by Houghten-Mifflin.

> pairs. Once you have a group of problems, have the kids work on the problems together.
>
> James: Your suggestions were wonderful! Once again you've confirmed I made the right decision in joining this research project. I think I might follow through with it. I will ask for some feedback from my math coach to see what he feels would be a good review strategy…
>
> Me: I am glad that participating in this research project is working well for you. Let me know what your math coach suggests. I would be interested.
>
> James: My math coach gave me a typical answer. "As the teacher, I trust you'll do what's best for your class. You know them best." That's true, but it was not what I asked. I was just looking for a suggestion. … I will take your suggestion of putting the ball in their court, I really like that. (E-mail Correspondence 4/16/07 – 4/18/07)

There are many instances over e-mail and in the informal interviews after class that the participants asked for suggestions. This need for advice continued in the group meetings, but it was less specific to their classes for a given day.

For the community of practice, my plan was to look at the practices of the participants in the group meetings as they reflected on their teaching, worked with mathematics and mathematics education, and discussed the issues of teaching within the structures of an urban environment. This plan evolved, and I found myself supporting the participants in their reflections, and their work with mathematics and mathematics teaching and facilitating their discussions in relation to the curriculum, the pacing

calendar, and other policies. This support in the group meetings can be seen as a continuation of what was happening in their classrooms.

More specifically, my role in the community of practice began by setting the agendas for each of the group meetings based on ideas that I wanted the participants to explore. Furthermore, I finalized the video clip choice, and the participants supported me (see Appendix A). At the beginning of the meetings, I began the discussions by setting the stage. The participants introduced the clips with occasional help from me; a specific issue was introduced, and I ended the meetings with a closing activity such as a written task.

The participants and I were usually on task for the meetings. Aspects of our personal lives entered the meetings occasionally, though this was usually a needed diversion. Regarding the content of the discussions of the meetings, I would have liked more discussion on mathematical content, but the participants' conversations tended to focus less on this and more on other issues affecting their teaching. There were some instances in the meetings where I noticed that I cut off the conversation of the participants. These instances could be categorized as my wanting to alleviate discomfort in the participants or my wanting to put my two cents in regarding pedagogy. Some of my involvement in the group meeting can be attributed to the need for a facilitator or someone of authority in a group meeting (Lave and Wenger, 2003; Lipman, 1988).

The plan for these meetings was supported by my desire for the participants to improve their mathematics teaching. However, my personal agenda was to see how they worked with mathematics and experienced some of the policies that affect their teaching. To that end, I purposely asked questions to make them think about mathematics content,

and I had segments in the group meetings where we discussed the curriculum, the pacing calendar, and math coaches (see Appendix A). Some of my reflections on how these worked in the meetings show that sometimes the participants did not "take the bait." In my reflection of Group Meeting 3, I wrote how I led them to talk about classroom interruptions: "It did not seem to phase them; they just accept it as part of their job." Some of my reflections demonstrate the benefits of bringing up these topics of discussions: "I feel that the resources that are available to new teachers are not necessarily used to their potential." I made this comment in reference to what the new teachers thought about the pacing calendar and how they only became aware of certain parts of it in February.

Most importantly, as I review the participants' comments and my own reflections about the group meeting, it is apparent that the participants saw me as another resource, as someone who is knowledgeable about content, curriculum, and other needs. At the end of the video clip viewing in Group Meeting 4, I made some suggestions about other ways to teach a topic. "Then Julia asked a question about multiplying by a decimal" (Reflection, 5/29/07). I also saw them as using each other as a possible resource, "I think they were getting ideas from each other" (Reflection, 3/1/07). This is in reference to James's suggestion after watching Julia's lesson on modeling integer addition and subtraction, to have the modeling of what they are doing written down. Julia said that "one of my professors suggested always using the students' names because they get more involved if they see some connection," or Jessica commented in relation to the benefits of seeing James's teaching, "one thing I liked that I don't do [is] asking them to solve the problem as a group" (Group Meeting 1, 3/1/07).

I mentioned previously that my identity, as the participants saw me, was as a mentor. It is interesting that in my reflections of the group meetings, I questioned the benefits that this study would have for the participants. During the first group meeting, we all introduced ourselves. My story might not necessarily fit what they might have been used to hearing in their profession. As I result, I wrote in my reflection, "I felt as if I needed to justify why I was qualified to do this research and possibly help them." Furthermore, I was obviously concerned about the impact of this study on the participants, myself, and the greater educational community: "I am a bit worried about what benefit my participation will have. I am sure I will learn a lot, how will it change my identity? What about the benefits to others?" (Reflection, 3/1/07). By the end of this study, my own identity had changed. I was very comfortable seeing myself as a mentor because of the praise and comments from the participants of thanks for being a part of the study. Furthermore, because of my involvement in their classrooms and schools, I saw myself as more knowledgeable about urban school environments.

My influence on their discussions is also important in analyzing my role in the community of practice. The most obvious effect in relation to discourse was how in Group Meeting 1, I made some comments regarding the video clips about the questioning style of the participants: "Think about questioning – instead of, 'Does everybody understand?' Ask a student to re-explain." In follow-up group meetings, these are some of the comments by the participants:

Group Meeting 1

Jessica: I just felt that I asked a lot of questions of the students and then answered them myself (*which was followed up by)*

James: I do that all the time.

Group Meeting 4

Julia: I should have asked what the errors were of the students instead of just giving them an error.

James: Direct questions to specific students began to happen toward the end.

Changes for the Participants in Relation to the Community of Practice

The agenda of the meetings in relation to the clips, topics of conversations, and the mathematics contributed to changes in the participants. The relationship with me was further extended into the teachers' classrooms and in informal conversations. The community of practice enabled the participants to have an informative and productive relationship with one another as well. What follows is a discussion of the conversations that occurred after watching the video, regarding their identities in general, the effects on their teaching of mathematics and on their mathematics knowledge.

Videos. In my reflection after Group Meeting 2, I wrote that I already see some form of transformation, "they appear to have some common practice and a basis from which to talk from." I think that much of this common practice comes from observing each other's video clips. Though, at the end of Group Meeting 2, I was questioning the benefits of each of them observing others clips, maybe because of the casual nature of their comments, as in Sherin and van Es's (2005) framework of video clubs when the participants are at level 1, the teachers just notice superficial occurrences in the class. The participants seemed to get more involved in the video clips as the community of

practice progressed. They were starting to feel more comfortable presenting their teaching and commenting on each other's teaching.

By the third meeting, I was continuing to question the benefits of the clips as I wrote that the commentary by the participants is "not focused on mathematics or even on mathematics teaching" (Reflection, 5/10/07). Looking back, this comment appears to follow Sherin and van Es's (2005) framework of video clubs when the participants are at level 2, the teachers notice more specialized events in the class. James, however, was starting to question the mathematics while watching the clips. When watching the video of Julia unwrapping a cylinder (i.e., a tuna fish can) for students to explore cylinders, James stated, "I was saying circle too, just like the kid, when you said, 'When I take this off, what shape would this be?' I was like circle, that was very interesting… so that is how you measure the volume?" One could say that James was starting to move on to level 3, the teachers focus on one particular approach to math thinking and move toward looking at the details behind the students' thinking, or he was at least between levels 2 and 3. In the final group meeting, I was trying to wrap up some topics I wanted the participants to be aware of so I tabled the video clips until later in the meeting. We had not really had an opportunity to talk about the pacing calendar, so I started the meeting with a discussion on the pacing calendar and the *Everyday Mathematics* (2004) curriculum. My comments about the video clips demonstrates that they needed me to push them into what Sherin and van Es's (2005) refer to as level 3, "I supplied the comments about the math thinking, the teachers seemed to be receptive" (Reflection, 5/29/07). Though, they needed some facilitating to get more information out of the video

clips, they seemed to appreciate observing each other teaching and began to incorporate the information they were getting into their teaching.

Identity transformation. Working within the community of practice, specific conversations regarding the participant's identity were not readily apparent. I originally wanted to focus on identity and use a framework supported by Gee (2000-2001) who described identity as being dynamic, socially and internally constructed, and influenced by one's actions in relation to the specific environments in which they are situated. I found that Van Zoest and Bohl's (2005) mathematics teacher identity framework added to Gee's work in that a teacher's identity is connected to what is enacted in the classroom. What follows in this section is a description of the participant's identity transformation either through personal comments, comments by others, or observations by the researcher. This discussion is relevant to how the participants refer to themselves in relation to a situation, refer to themselves as others see them, and how their identity is enacted in relation to their actions in the community of practice and even in their classrooms.

My hope at the beginning of this research was that the participants' statements would take the possible form of "in my math class" or "I think…" but even from the first group meeting the comments about what is a mathematics teacher took the form of "they…." This might be because they did not see themselves as the stereotypical or traditional mathematics teacher but as a teacher of mathematics. "They are very organized and prepared ahead of time" (Jessica, Group Meeting 1, 3/1/07) or "the typical math teacher is a boring looking math teacher with the kids sitting in a row looking bored" (Julia, Group Meeting 1, 3/1/07). When asked which postcard represents how

James sees mathematics teachers, he started his conversation with "we start out on the ground, and as we start learning more and experiencing more we start taking off. Experience is the best teacher" (Group Meeting 1, 3/1/07), referring more to a teacher of mathematics and more importantly, a new teacher.

In relation to their schools and their classrooms, the participants present varying levels of their knowledge in mathematics and mathematics teaching. They all present themselves as strong in mathematics but need to improve their mathematics teaching. This view is carried into their school environment to some extent. Jessica has a good working relation with her math coach in helping improve her teaching of mathematics and even more so in organization and pedagogy. Her content knowledge is seen as a resource to fellow teachers in how she is able to break down the knowledge in a step-by-step way. Julia is pretty much left to her own devices at her school because the school/coach and colleagues see her class as problem free. James is seen as dependent on his colleagues and mentors for ideas in pedagogy and mathematics, though this might be the culture of the school. There is a concern by the participants about how they are perceived in their classrooms in relation to the students. "If I don't have everything ready right away, I will lose them" (James, Group Meeting 3, 5/10/07) and "When you called me over I thought you were testing me because I knew you knew the answer" (Julia, Group Meeting 3, 5/10/07) are examples of the teachers not wanting to be put on the spot in their classroom.

In relation to the community of practice, the environment is collegial and comfortable. There is laughter, praise, suggestions, and even some criticism. The way the participants see each other or themselves in the community of practice is interesting.

James at one point says to Julia, "You have a strong mathematical mind" at which point Julia smiles, laughs and says "Thanks." James also said to Jessica, "You think fast on your feet" at which point Jessica says that she has to, but is shaking her head saying that she 'thinks what she said about paper and pencil in the supermarket was …' The way that James sees himself appears to be someone who can give suggestions, encouragement, or advice possibly because he is in his second year. In response to the compliment, Jessica begins to make a comment that seems to be in disagreement. Throughout the analysis, there is dialogue from the group meetings in which I coded instances in which James makes the suggestion. He suggested that the modeling of what they are doing when they are walking (i.e., for integer addition) could be initially written down (Group Meeting 1, 3/1/07), and he explains a possible way of modifying a lesson using shared information (Group Meeting 2, 3/29/07). James also comments that a step-by-step of how to calculate the volume should be posted in the room, it was there but "you did not refer to it" (Group Meeting 4, 5/29/07). The participants were all open to comments, suggestions and critiques from each other and myself.

The participants' actions in the community of practice demonstrate to me that they are all comfortable with mathematics but recognize that they need and want help in their teaching of mathematics. They very rarely asked content questions, but as I said earlier this may be because I did not push the issue. There were times of uncertainty in their knowledge when their voices would trail off. There were times when they took the role of authority and made suggestions about teaching, and there were even times when they kept quiet and did not want to contribute at all.

Mathematics teaching practice. A participant's identity is intertwined with his or her actions in relation to mathematics teaching practice and mathematics. What follows are some scenes that exemplify the participants' identities. The way these teachers view teaching mathematics can be understood by looking at their views of their students' learning and comprehension of mathematics. During the group meetings, we discussed not only mathematical content, but also pedagogy. Much of the conversations of pedagogy occurred after viewing the video clips. When discussing the students and the teaching of mathematics, Julia seemed to brighten up with any new idea that was presented but often did not follow through in her class due to the need for extra planning or due to her need for control.

> Because I am used to leading a teacher-directed classroom, I felt very disorganized just letting the students work in groups. I felt out of control. I realize, after watching the video of the lesson that most of the talking was about the shapes and students were learning by being in groups, even though the classroom was loud. (Julia's Reflection, 4/30/07)

In this case, Julia wanted the students to explore in this lesson on shapes. This is after having a discussion in Group Meeting 2 where James stressed how he always has his students work together especially "mixed ability groups [though] some teachers like to have all the strong kids together but I like it more heterogeneous" (Group Meeting 1, 3/1/07). This conflict continued with Julia throughout the semester as she stated in the last group meeting (Group Meeting 4, 5/29/07),

> I find when I do that [group work] with them, it was going so great and they were following and the energy exploded … if they are load it's not talking about math … I do need to work on this.

After working on a mathematics problem in the Group Meeting 3, Jessica seemed to be less confident about her ability to incorporate certain things into the classroom. The two reasons that Jessica gave were that there was no time to complete the curriculum and that she did not think her students could handle it (Group meeting 3, 5/10/08). While, Julia thought her students would solve problems the way she did as they have had practice thinking about intervals.

Similar to research about teachers teaching the way they were taught even with the knowledge of reform mathematics (Warfield, et al., 2005), Julia sees the necessity for students to explore. She stated "I think it's important to nurture students' exploration in learning. It is definitely more difficult to teach this way and moderate, but I think it has value and I hope to be able to do it more next year, especially now [that] I am more familiar with the content" (Julia E-mail Correspondence, 6/6/07). But in the end, she kept mainly teaching the way she was taught. She indicated, "I think the lesson would have gone better if I did it in a teacher-directed style" (Reflection, 5/23/07). This followed into her second year where her language in e-mails supported a teacher-centered approach. For example, she stated "They will pick up on it after I teach a full lesson on it" (Julia E-mail Correspondence, 9/30/07).

James made this comment in the last group meeting:

> It is difficult – you have to take in to account different learning styles – when you are teaching in one classroom filled with kids, not everyone is going to get it.

> You are basically teaching all those kids at one time all the same. It is very very difficulty to teach anything. You also have to worry about "Is my lesson conceptual? Am I engaging my students? What do I do in case this happens?" The mathematics is, I don't think there is anyone who can say that there is the 100% correct way of doing this.

This quotation demonstrates one of James's struggles which is how to work with all of his kids all of the time. As he sees it, group work is his way of getting to as many kids as possible and helping them to grasp the material. In another comment, he appears to be making this statement to not only the other members of the group but also to himself, "You really have to be very smart and patient to be successful at this" (Group Meeting 4, 5/29/07). Jessica feels that she can tweak stuff because she knows the content she is trying to teach. But then in agreement with James, they acknowledge that "It, knowing the content, can be also a disadvantage for [the teachers], because learning mathematics was so easy" and you might be thinking, "Why can't they just say …"

Mathematics practice. There were only two instances in the group meetings where the participants were working hands-on with some mathematics. The other times that mathematics was practiced were in relation to the video clips, examining content that was presented in the teachers' classes. When working on *Petals Around the Rose*, Julia was able to determine how the game works and although she played along, Jessica seemed to be frustrated with not being able to get it in the initial five minutes of play. Some people are uncomfortable when activities or problem solving are not necessarily cut and dry.

When working on problems during the group meetings, Jessica expressed more enthusiasm for the concrete problems such as problems with algebraic solutions. This is interesting in light of her response to the questions on the Participant History Survey. "My favorite thing about mathematics is the ability to figure things out. If you keep trying, you WILL get the answer" (Jessica's Participant History Survey, January 2007). During Group Meeting 3, the participants were given the problem "Are we there yet?" (Problem of the week, www.mathforum.org).

> With summer winding down, Mr. and Mrs. Mallery decided to take their family to the beach one last time. They loaded their kids, Olivia and Liam, into the car and headed off early in the morning.
>
> At 7:05 am Olivia asked, "Are we there yet?"
>
> "We're one third of the way there," replied Mr. Mallery.
>
> At 7:25 am Liam asked, "Are we there yet?"
>
> "We're 75% of the way there," said Mrs Mallery. "Now, can you two figure out? What time we should get to the beach?"
>
> Can you help Olivia and Liam determine what time they will arrive?

While working on this problem, both Julia and Jessica attacked it in complete silence and individually. After about 4 minutes of silence and pencil and paper solving, Julia appeared to be finished. Jessica looks over at Julia and laughs. Julia notices that I am solving the problem as well and asks whether I know the answer. I respond that I do, but I am trying to solve it another way. She notices that I am using algebra and says in shock "algebraically." Jessica responds that that is how she tried it. And then Jessica invites Julia to look at her work. She laughs and appears a bit nervous and Julia responds with a

"Wow." It appears that both Jessica and I are having difficulty solving the problem algebraically. I thought it would be welcoming to all if we were all working on the problem at the same time. I found the algebraic approach to be confusing. Julia approached the problem non-algebraically and got the solution, while Jessica approached it algebraically and was getting stuck. After about seven minutes, we begin to discuss the problem. My own reflection on this activity was that the use of the *Everyday Mathematics* (2004) curriculum was probably a great way to get teachers to think differently about mathematics.

The participants' discussion was focused first on the mathematics and then on the students who they were teaching. One of the ideas that came out from both Julia and Jessica was that this problem could be adjusted for their students. Jessica stated that her students would try to adjust the problem themselves to make it easier to solve and Julia commented that switching the intervals to be five minutes would be easier to solve. This activity enabled the teachers not only to work on problem solving but also to discuss a problem in relation to their students. The ability of the teachers to modify problems based on their students' thinking is a valuable skill and something that the students would benefit from. Being able to help children learn mathematics works in conjunctions with teachers learning to teach mathematics. Warfield et al., (2005) discuss the importance of communication among teachers as well as among children. The communication gives teachers the "insight into their children's understanding, insight that can be used to plan subsequent instruction." Moreover the authors stress that "the sole purpose of talking about mathematics is for children to see new problem-solving strategies that they can use in the future" (p. 454). My hope in having the participants in this study talk about

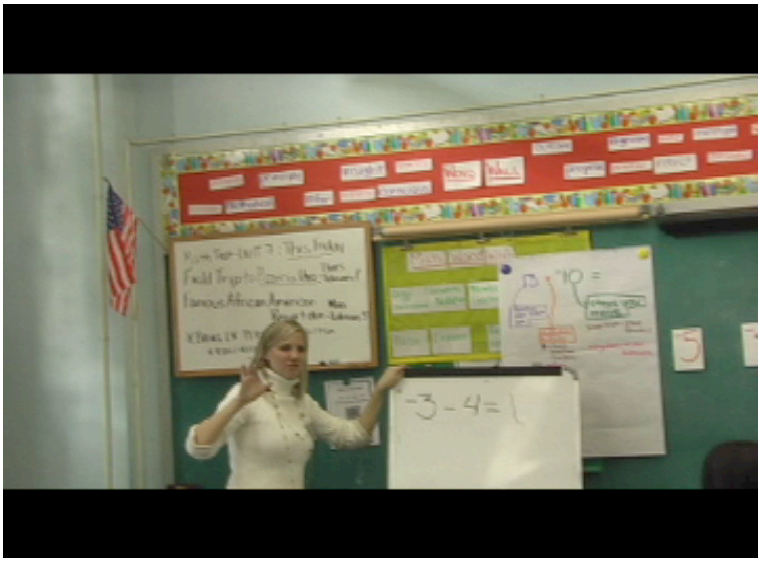
mathematics was for them to have the opportunity to see what and how they could use something for future teaching and learning.

Here is a vignette that exemplifies the teachers working with a mathematics topic that came from a video clip during group meeting 1, 3/1/07.

Here is part of the clip that the participants observed.

> The end of the clip has Julia explaining a problem just demonstrated by a student walking along the number line. "He started at negative 3. He is facing this way and minus one, two, three, four and we end up with, what do we end up with?'
> Students: One
> Julia: One, how many of you are seeing this? How many of you are still a little iffy?
> A couple of hands go up.
> Julia: All right, Adrian sit down. Anyone else what to try it? Okay, Michael.
>
> The video ends here (see Figure 2). I would like to note that I broke off the video at this point to make it a teachable moment for the participants in the study and I wanted to see what their reactions would be. In the actual class, Julia has Michael come up to the board and as he is coming up she erases the problem on the white board. After two more examples she is working with a problem of -1-+3 and realizes that the number model that she is writing down and what the students are giving her is contradicting something. She does a problem correctly for -1-+4 to get -5. This concept is never formally revisited in the class. In addition, in Julia's reflection of the class, her comments dealt with pacing of the class, student behavior/control of students, and the amount of preparation for the class. She did mention that the idea for the visual demonstration came out of the math book, and that it seemed to work well with the children.

Figure 2:



After viewing the previously mentioned lesson in which Julia was teaching addition and subtraction of integers, the following conversation occurred:

James: So (pause and nervous laughter).

Me: Were you about to say something.…

James: I thought it was negative 7.

Me: Mmm (smiling).

Julia: I'm I'm sure it was. (Laughter from all) cause.

Jessica: Yeah, cause I was definitely trying to figure it out.

James: I was thinking, they're teaching it wrong (the "they" that he is referring to is *Everyday Mathematics*).

Me: So, this is one thing I think is you were erasing after every example.

Julia: Yeah, well and I didn't even write and that was another thing that I was going to say, what I think I should have done is written down the examples and have them copy them down in their notebooks, so that they could….

Me: Right, right something because that would have somebody who would have corrected it.… One of the problems was that there was no plus sign there. One of the things that I have done when I am introducing integers is to write down everything using the positive and negative symbols.

James: Do you do it with parentheses?

Me: No, you don't need to.

And that was pretty much the end of the content material though after a bit more discussion Julia added this comment. "It is a confusing thing and part of the reason was I ... I tripped up and I felt like I had Adrian up on the board for way too long but I think it

was because I wasn't secure in the method. I was like let me do one more example so that I get this and maybe that is why I had Michael come up to the board *because I needed* more examples." (italics emphasize her inflection)

A topic is brought up. There appears to be some discomfort. I, as the experienced teacher, feel this and don't want them to feel bad and the topic quickly moves away from mathematics content talk. A couple of content questions are asked but not as much as I had previously hoped for. When I was laying out the structure of the meetings I really wanted to see what the participants brought to the meetings and not have the content completely guided by me. However, it does seem that I did take some cues from them and tend not go in a direction that I had originally intended.

During the last group meeting, after the participants watched the video clips, much of the constructive criticism and suggestions were based on the teacher's pedagogical knowledge. I introduced suggestions based on the mathematical content. After Jessica's clip on using different algorithms for multiplication, I picked up on the fact that when the students are multiplying 8,000 by 6 she tells them to disregard the zeros and affix them back later. This led to a conversation about how to teach this better to help them with their number sense. This led to Julia to ask about a situation of when she teaches multiplication with decimals such as 30 multiplied by 5.8. This was an interesting session in that the teachers were noticeably thinking about the mathematics behind what they were teaching. Such comments, like Jessica saying, "Technically, you are not doing multiplication by a decimal" and Julia recognizing what the students are thinking, "Because they are doing it that way, they are not thinking that way [parts of a whole]." And "that's why if kids [put the] decimal, in the wrong place, they won't catch

it, because they don't have any idea and they won't check it and say that answer is way off" (Group Meeting 4, 5/29/07).

The discussions with these teachers and the community of practice gave insight into the needs of such teachers. The specific findings are reported in this chapter, and I will now turn to interpretation and conclusions.

CHAPTER 5

DISCUSSION AND CONCLUSION

New teachers enter classrooms today concerned about many different issues, not only how to teach a specific topic, although this inquiry about how best to teach remains central to the profession. Looking at the situation of new elementary school teachers teaching mathematics in the New York City public schools, one finds that they must deal with the many policies that have been adopted with the objective of improving the teaching of mathematics and, as a result, the achievement of their students. These new teachers, especially if they enter the profession through one of the alternative route programs, enter the classroom with little prior knowledge or experience in teaching and with little prior knowledge about the context of urban public schools. They may or may not have mastery of the mathematics content, depending on their major in college. According to Ball (2003), not only should teachers have mathematics content knowledge, but also they should have pedagogical content knowledge and mathematics knowledge for teaching.

The changes in the way mathematics is taught and in the background and experience of the mathematics teachers have been occurring for over two decades. The changes began with the publication of the National Council for Teachers of Mathematics (NCTM) *Curriculum and Evaluation Standards* in 1989 and became more critical when the No Child Left Behind (NCLB) Act (2001) was passed. The NCTM *Professional Standards* (1991) and the NCTM *Principles and Standards for School Mathematics* (2000) pushed for mathematics teaching and learning that was grounded in conceptual

thinking and problem solving. Furthermore, the NCLB act required that all students be taught by "highly qualified" teachers (No Child Left Behind Act, 2001b) and that students be tested on mathematical knowledge each year. Researchers have investigated how these new policies and reforms have changed the experiences of new teachers and have proposed many ways to support new teachers in the teaching of mathematics (Ingersoll and Smith, 2004; NCTAF, 2005; Darling-Hammond, 2005).

This study's purpose was to inform our understanding of identity transformation of elementary school teachers in relation to their mathematics teaching by using the community of practice framework and by focusing intensely on three teachers. This study built on research in communities of practice (Lave and Wenger, 2003; Lipman, 1988; Wenger, 1998), mathematics teacher identity (Van Zoest and Bohl, 2005), identity (Gee, 2000-2001) and teacher learning and knowledge (Ball, 2003; Carpenter et al., 1996; Franke et al., 1998). The findings of this study indicate that an intentionally created community of practice based on mathematics teaching and learning continues the education and reflective practice of the participants. The practice that occurs in the community of practice develops from the classroom experiences of the teachers. The participation in the community of practice influences the teachers' experiences of teaching mathematics, not only in relation to the resources available to them, but also in relation to their own identities as mathematics teachers. Furthermore, this study puts forward the importance of an additional support system for new teachers in their teaching of mathematics that does not need to be connected to their school, although clearly communities of practice can be formed in and by schools.

Difficulties, Limitations and Outcomes as they Relate to the Research

Community of practice of new elementary school teachers. With the creation of this community of new elementary school teachers, it became apparent that the teachers who volunteered to be a part of this research saw this study as a way to improve their teaching of mathematics. This study became another form of professional development for them.

There were some hurdles in conducting this study. The first difficulty was finding participants, with the process taking more time than expected. The combination of gaining IRB approval and Department of Education approval became a lengthy process since IRB approval needed to be gained before submitting a request for approval from the Department of Education. Requests for participants followed approval. The delay in getting into the classrooms had the positive benefit of allowing the teachers to become acclimated to their schools and students, allowing them to focus on the teaching of mathematics. While the participants were enthusiastic, other possible participants were apprehensive about volunteering to be a part of the study. Although not one participant mentioned that this research would add to their workload, they were clearly overwhelmed by the work involved in their beginning teaching and continuing graduate study. Moreover, while the goal was to have teachers from both the traditional route of teacher education and the alternative route, known as the New York City Teaching Fellows program, the number of elementary school Teaching Fellows accepted into the program has diminished over the years. This decrease is primarily related to the focus within the Teaching Fellows program on the need for teachers in areas considered to be "high needs" areas such as mathematics, science, ESL, and special education

(http://www.nyctf.org/). A "high needs" area is one where there are not enough certified teachers to fill the open positions. The need for elementary school teachers was satisfied in the first years of the program. There was a cohort of about 40 elementary school Teaching Fellows enrolled at urban university in the year of the study.

Part of the design of the study was to seek participants who had some commonality on which to build in the community of practice. Once I had two participants who were Teaching Fellows enrolled at urban university, I wanted my other participants to also be enrolled at urban university. The university was very accommodating in supplying me with a mailing list, but it was unclear from the lists who met the explicit requirements of the study; currently teaching in the New York City public schools, in their first year of teaching, and teaching third, fourth, or fifth grade. Some of the teachers who were interested in being a part of the study did not meet the criteria for inclusion (see Appendix B, Letter to Teachers).

Once the participants were identified it was found that they had some additional commonalities beyond the fact that they all were pursuing their Master's degrees in childhood education at urban university. The participants were teaching the same curriculum, although two were teaching third grade and one was teaching fifth grade. Furthermore, math coaches were available to each of these participants to help in implementing the curriculum, preparing for assessments, and providing additional support. The participants all expressed a love of mathematics and considered themselves to have been successful in the study of the subject. As we shall see, the participants involved in this study gave particular insight into the kinds of professional development needed for new teachers. Of course, since they volunteered for the study, it could be

argued that they were predisposed to gain something from being a part of the study, but the outcomes went beyond what could easily be attributed to predisposition.

Having three participants made the community of practice small and manageable, but this size at times limited the conversations in and contributions to the community of practice. Furthermore, some of the limitations of this study can be attributed to the personalities and backgrounds of the participants. Working in a community of practice means that one's participation shapes one's experience, as well as shaping the community (Wenger, 1998). Because two teachers taught third grade (i.e., Jessica and James), there was more opportunity for them to discuss common concerns and topics related to their teaching than for the fifth grade teacher (i.e., Julia). Similarly, the two Teaching Fellows (i.e., Jessica and Julia) had more of a shared background than the traditionally certified teacher (James). Furthermore, James, the teacher in his second year, contributed to the community of practice by taking on more of a role of authority, maybe because he had already worked with the curriculum for a year, because he was the only male, because he was somewhat older than the other two participants, and because the teaching environment at his school was very structured.

The community of practice has been used as a framework in which the practice has a transformative effect on the participant's identity, but more often than not the participant's identity has an effect on the activity of the community of practice (Wenger, 1998). The intent was for topics, issues, and ideas relevant to new elementary school teachers teaching mathematics in urban environments to be explored to further the education and reflective practice of the participants. To make this type of community productive for the participants, they have to have some agency (i.e., the power to act) in

what transpires during the community of practice. What topics the discussions covered could be attributed not only to the set agenda but also to the participants' agency, which is influenced by his or her desires and interests.

A community of practice is a "place" where the participants develop the skills to reflect on their practice, pursue topics related to their practice, and have collegial conversation and discussions that can then be extended to their schools. In other words, a community of practice gives the participants the opportunity to learn the skills necessary to practice the activity of teaching in a "masterful " way. The use of the term mastery was coined by Lave and Wenger (1998) to refer to the end point of the learning model of apprenticeship. Most important, in looking at an intentionally formed community of practice, it is necessary to note that this intentionally formed community is not the only community of practice that the participants are a part of (Wenger, 1998). Lave and Wenger's (2003) work mentions the difficulty of creating communities outside of schools. One of the primary purposes of professional development is to give teachers the skills and knowledge to continue in their profession. "However, because the communities are external to schools, application in the classroom may be difficult" (Culpepper, 2004, p. 24).

Informal mentorship and observations in conjunction with the communities of practice. A significant segment of the research design of this study was the bi-monthly observation of each participant. Even though great care was given to how the data would be collected in this part of the study and to how this part of the study was conducted, occasionally the video clips that were used in the community of practice to further the learning and reflection of the participants did not reflect the specific lesson segments that

the participants, including me, recalled as being particularly instructive. Furthermore, since I was a participant observer in the classroom, there are times in the video when I was filming the teacher but one could only hear my voice and the voices of the students I was helping. Although this restriction may have had an adverse effect on the discussions during the community of practice, these instances became helpful to the participants in other ways during their subsequent viewings of the observations on their own. The teachers learned not only from watching their own teaching, but also from watching the students learn and from listening to the conversation between the students and me. The reflections of the observations by the participants were sometimes not written within a day of the class. This delay in writing the reflections gave the participants a broader scope for reflection since the participants had follow-up classes to inform their reflections. Therefore, their reflections may not only be directed to the specifics of the observed class, but may also be reflections on other teaching experiences.

Developing this research intentionally to help these teachers teach mathematics was a driving force behind the design of the study. Not only was the study meant to inform the research community about new elementary school teachers and the teaching of mathematics, but also, it was meant possibly to help these participants to take on the role of leaders in their own school communities. As Stein et al., (1998) state, "placing the study of teacher development in a community of practice framework implies that motivation to learn is tightly tied to teachers' views of themselves as aspiring members of a reform mathematics community" (p. 38). The crux of these new teachers' experience is becoming part of the community of teachers. As they continue their practice of teaching

and consequently their involvement in a reflective practice, they develop "an increasing sense of identity as a master practitioner" (Lave and Wenger, 2003, p. 111).

Finally, I explored what happened in this community of practice in relation to Sherin and van Es's work (2005) with video clubs. The reflective practice of the teachers' teaching was conducted with the use of video. Since this study only took place over the course of four months, there may not have been enough time for the participants to develop the skills that are mentioned in the work of Sherin and van Es. The participants were starting to move into what Sherin and van Es refer to as level 3, focusing on mathematics thinking and beginning to look at the mathematical thinking of the students.

Research Questions Revisited

The five research questions that were developed for this study were formulated before the research began. They were constructed in relation to the current policies that affect new elementary school teachers as they teach mathematics in urban schools. Based on the research design and the data analysis, the research questions were explored. What follows is a summary of the findings in relation to the research questions.

The first research question was, Do new elementary school teachers navigate the teaching of conceptually challenging mathematics within the structures of urban schools? And if so, which resources do they access and how do they use them? In connection with this question, I incorporate a discussion of the research question that asks, Do these new elementary school teachers provide opportunities for their students to engage in conceptually challenging mathematics? If not, what are the obstacles? In order to discuss

these two questions, the observations of the teachers' teaching are important data sources. To further the discussion, the conversations that occurred in the community of practice were analyzed in conjunction with the teachers' reflections. The dialogue in which a teacher would refer to the mathematics thinking or lack of thinking of the students was found to support whether or not the teachers provided thought-provoking instances in their class lessons.

One could argue that conceptually challenging mathematics rarely occurred in the classrooms. First, in the beginning of the study the participants refer to mathematics as black and white, as always having a right answer, or as the universal language. These views are contradictory and at times, the contradictory nature of these views found expression in what happened in the class. In light of this overarching view of mathematics, each of the teachers make a point to comment on the critical thinking necessary for mathematics learning, the importance of exploring a topic, and the necessity for students to "think out of the box." An example occurs in two of Julia's classes in which she had the students exploring three-dimensional shapes and then calculating volume. The exploration of the properties could be described as conceptually challenging since the students were given an opportunity to question what they were determining. This exploration was followed by the calculation of volume, which was taught very procedurally to the point that Julia wrote the steps on the board ahead of time. Furthermore, the individual teacher's understanding of what his or her students would do when confronted by a more challenging problem seemed to be an example of how the teacher, himself or herself, explored conceptually challenging mathematics. Julia's response, when asked how her students would work through a problem, was that they

would do it the same way as she did because that is what they have been working on. Similarly, when asked the same question, Jessica stated that her students would just try to make the problem easier and do an operation that they are familiar with even if it has no relationship to the problem. In theory, the teachers might give the students the opportunity to engage in conceptually challenging mathematics but that does not appear to be so, based on how the classroom actually functions.

The teachers may want to encourage deep understanding of mathematics but are still trying to figure out issues of pedagogy. Finding this discrepancy is consistent with Ball's (2003) work on teachers needing more than just content knowledge to teach mathematics. In certain instances, the participants commented on how each of the teachers asked questions and either answered the question themselves or kept on looking for the one student to give the "one right answer" (Group Meeting 3, 5/10/07; Group Meeting 4, 5/29/07). This discussion about questioning went further for the participants in that they began to recognize that they were also answering their own questions and that some of their questions were being asked in a way to push the students towards a specific answer, "do you understand?" instead of "can you (re)-explain to the class …"

Since these teachers taught from the *Everyday Mathematics* (2004) curriculum, which both challenges the students and teaches the students what they need to know, they are influenced by the features of the curriculum, such as real-life problem solving, balanced instruction, multiple methods for basic skill practice, and an emphasis on communication. For example, the teachers used literature to preview a mathematics lesson, as suggested by *Everyday Mathematics* (2004), asked the students whether they saw parallel lines in the real world, used a ruler, string, and straws to construct parallels,

used manipulatives and visuals for a volume lesson, and had the students working in groups to explain fraction problems using chips. These teachers used these resources to support their teaching of conceptually challenging mathematics. One could argue that other resources, such as the pacing calendar, were taking away from this type of thinking. James recognized that the reordering by his school of the pacing calendar to coincide with the state assessments detracted from some of the scaffolding that *Everyday Mathematics* (2004) encourages, and Julia commented on how she went really fast through the pacing calendar to keep the students motivated and interested.

However, even with the influence of a conceptually challenging mathematics curriculum, is conceptually challenging mathematics being taught in the classroom? Often when a teacher "encouraged her or his students to engage in the practices of reasoning, explaining, and investigating," (Cooley, et al., 2006), it was of a superficial nature. The teachers often supplied connections after an investigation as opposed to having the students make the connections. The teachers would ask a thought-provoking question and proceed to answer it themselves, thus not giving the students the opportunity to engage in the thinking process. It is important to note that, in some lessons, a teacher may not have taught conceptually challenging mathematics or supported his or her students in these activities, it often depended on the particular lessons.

The three participants, James, Jessica, and Julia conveyed the importance of teaching conceptually challenging mathematics, and they all tried very hard to incorporate it into their classroom at one time or another. It appears from the observations that James's mathematics classes came the closest to having the students engage in conceptually challenging mathematics on a consistent basis. Every class that

was observed had some group activity where the students sat in a cluster and discussed, questioned, and answered one another about how to solve the given problems. James's questioning or prodding usually took the form of "Why do you say that…," "How did you determine that answer?" and "I don't understand. Can you explain it another way?" Jessica and Julia's classes did this type of activity less frequently, and as a result when it occurred the students were not as comfortable discussing, questioning, and answering one another about the problems as students were in James's class.

An important part of the teacher's teaching of conceptually challenging mathematics is his or her own perception of the students and of the mathematics. Some instances follow that I coded in the group meeting and the participants' reflections of student behavior in relation to mathematics and of conceptually challenging mathematics.

> Think Pair Share and Turn and Talk are things we are always working on in creating a culture in the classroom. (James, Group Meeting 4, 5/29/07)

This comment was made after viewing a class in which Julia's students were investigating volume and three-dimensional shapes while working in groups and sharing their information with the class. James was being supportive of Julia who had previously expressed discomfort with the approach of using group activities in her class because she wasn't sure how much of the talk was mathematics related. Julia's efforts to incorporate more lessons that contained group learning and exploration were influenced by participating in the community of practice. James, who does this type of instruction thought it was a great way to teach volume and three-dimensional shapes, as it is "productive energy" (James, Group Meeting 4, 5/29/07).

In a lesson in which Julia had her students explore possible formulas for the area of a circle, she wrote in her reflection: “Many students were angry with me for not just 'telling them the formula,’ which I can understand” (Julia, Reflection, 4/17/07). The difficulty she had with engaging the students could be attributed to her tendency to move quickly through the material and seemed to say that she did this to keep her students who “already knew it” motivated and interested in what was going on in class.

> I don't know if this is across the board or just my class. If [sic] a problem is complicated or has more than one step, the kids tend to simplify it and do the most simple thing instead of thinking about what the question is really asking. So as a result, math has becomes sort of a way for me to get the children to think critically. (Jessica, Group Meeting 1, 3/1/07)

This is followed by a situation in a lesson when Jessica’s student stated that the reason (25-8)+7 and 25-(8+7) had different answers was that the parentheses were in different places. Jessica was pleased with the choice of her next example as (14+8)-3 and 14+(8-3) to counteract this, though she did not ask them to think critically by asking them why the first example gives them different answers and the second example does not.

How are they teaching the mathematics? The resources that they use for their teaching is mainly the *Everyday Mathematics* (2004) curriculum, the pacing calendar, their math coaches, and their prior knowledge. All the participants follow the *Everyday Mathematics* (2004) curriculum and the supplied pacing calendars somewhat closely unless the material does not fit with the teachers’ prior knowledge.

> When I reviewed the teacher's manual, I found it to be confusing. So, I decided to create my lesson more in terms of guess and check

> and discovery of formulas. The idea of having each group test a formula came to me on the spot, and I like how it worked. I liked that students were able to definitely say that a certain formula wouldn't work, and this showed some conceptual understanding. (Julia's Reflection, 4/17/07)

As is evident, there may be opportunities for conceptually challenging mathematics with the use of *Everyday Mathematics* (2004) but the students are not necessarily given these opportunities. Furthermore, the other resources available to the teachers play a greater part in completing the standardized curriculum. The math coaches were most often used as a resource for supplies. Although Jessica did state that her math coach modeled lessons, I am not aware of how these lessons were modeled. Some of the limitations in teaching conceptually challenging mathematics and supporting creative thinking about mathematics on the part of the students appear to be the extent of the mathematical knowledge of the teacher, time constraints of the classes, and a difficulty in communicating with the students and vice versa.

The research question that asks, How do the participants identify themselves as "teachers of mathematics"? Do their ways of identifying themselves change over time as they become involved in a community of practice/inquiry? If so, in what way(s)? Looking at the teachers, I found that these teachers' identities changed by being involved in a community of practice. However, I would say that they identified themselves less as a "teacher of mathematics" and more as reflective practitioners of their mathematics teaching by the end of the study.

The first requirement in answering this question, is defining the term "teacher of mathematics" precisely. When developing these questions, I was thinking about myself

as a mathematics teacher. Mathematics is the subject I teach, and in every community that I am professionally involved in, I am identified as a mathematics teacher. Furthermore, throughout my years of teaching, I was constantly modifying my teaching, investigating and learning new ways to teach, learn, and approach certain topics. The teachers in my study have a different experience, mainly because they are elementary school teachers. They have taken the first step in that they volunteered for this study, which demonstrates that they are trying to increase their knowledge and experience from just being good at mathematics (Van Zoest and Bohl, 2005). The teachers' beliefs and knowledge about the actual practice in the classroom changes over the course of the study. The participants became more aware about their questioning style in that a certain type of questioning is more beneficial to the students' deep understanding of mathematics. The teachers found that by their supporting certain types of mathematics practice in the classroom, their students became engaged in mathematics in a different way. In the cases of Jessica and Julia, for example, the first few observations reflect very little group work or exploration but as the study progressed, these teachers began to try to incorporate more group work and exploration in the teaching of mathematics. James, on the other hand, was already aware of using group work and exploration in the teaching of mathematics. However, he became more attuned to the many nuances of mathematics, asking questions about the content himself. The other influence on the teachers through the community of practice is an awareness of how to use the resources available to them. This might not be thought of as a way to identify as a teacher of mathematics but the more knowledge a teacher has about the resources available, the greater the opportunity to use these resources to teach mathematics well.

From their involvement in this study, I believe that the participants' ways of identifying themselves have changed over time. For example, they have become more confident in their own teaching. In one of James's last observations, he described how he spent a large amount of time trying to get the students to give him the correct answer to a question. The class was getting completely confused. Students were repeating incorrect responses, not reading numbers correctly (3.2 as 'three dot two'), and becoming disengaged. After some comments from the other members of the community of practice, James was very comfortable admitting what he perceived as going wrong in that class. He would not have felt so comfortable in the first few meetings as James was usually trying to demonstrate some certainty in his practice. Julia seemed more confident in trying new things in her classroom, be it group work or working with manipulatives. Jessica was the least outwardly changed, but from her own reflections and comments during the group meetings, it is apparent that she did change in how she looks at her own teaching. She became more critical about the actual lessons that she teaches and started to reflect more on how she decided to teach a lesson.

> I was looking at mental math because it is one of my next lessons. I was thinking about cutting it out because of time. But now that I have seen it, I see how beneficial it is. (Jessica Group Meeting 3, 5/10/07)

The second difficulty with this research question is whether or not the possible identity transformation is dependent on the participant's involvement in the community of practice. There really is no way of knowing except from the participants' comments about the benefits they received from being a part of this project. It is important to note, however, that some of this transformation could be attributed to having the extra

mathematics person in the classroom during the days of observation, as well as to the increased communication outside of the classroom.

Working within the community of practice, identity conversations did not just come up. What came up was the idea of learning and reflecting and changing from being a part of this research. Did this learning and reflecting change the teachers' identity as mathematics teachers? Their participation in this research project made them think more about the teaching of mathematics, but there are still so many other issues that interfere with thinking about mathematics in relation to one's teaching that one cannot attribute the change in the teachers' identity solely to the activities of the community of practice.

The third research question asks, Does the researcher's participation in a community of practice/inquiry transform her identity of teaching mathematics in an urban school environment? If so, in what way(s)? For all of the participants including myself, this research project was invaluable for many reasons. For myself, I learned much more about how differently policies affect every school. No two math coaches or math coach situations are the same, not every school has the same amount of mathematics time, and even the standardized curriculum is not standardized either among schools or within schools. Julia was two units ahead of another fifth grade class in her school, but James's school had everyone doing the exact same lesson on the same day for each grade. The overall enthusiasm in the classrooms I observed and the teachers I worked with were exciting to be around. It was wonderful for me to be back in the classroom working with students. Most important, I found my role as a mentor to be both enlightening and rewarding. Interacting with these teachers by helping them with the teaching of mathematics made this project enjoyable. Overall, I think the extra support of having

another mathematics teacher in the classroom was a valuable tool, resource, and support for these teachers.

For the participants, their statements about themselves in relation to this project demonstrated that they became more reflective in their teaching, more aware of different practices. and more knowledgeable about the mathematics that they were teaching. Julia stated in a reflection. "I now know what I will do differently next time (Reflection, 3/12/07). She stated that the videos enabled her to see the progress in her teaching and that being part of this research has changed her. She says that she is more confident in her teaching and that the study has given her the ability to reflect (Julia's Reflection, 4/30/07). James actually declared that he had become a reflective practitioner (Group Meeting 4, 5/29/07) and Jessica saw herself not taking the curriculum at face value but, for example, questioning the ordering of topics. She began to see ways of teaching a topic other than the way the text suggested (Group Meeting 4, 5/29/07). They all were comfortable with mathematics, but they still wanted to improve how and in what way they taught the content.

The final research question, Does the path taken into teaching elementary school mathematics affect these teachers' identities as mathematics teachers, their preparedness to teach mathematics, or their manner of accessing and using resources and, if so, how? This question was never really approached during the data collection. Before the research began, I thought that during the community of practice the Teaching Fellows would rely more on the information gathered from their graduate courses while the participants who entered the profession through a traditional route would be more inclined to rely on the resources available at their schools, possibly because of having

more student teaching. There was only one instance in the community of practice where there was a reference to university courses. Julia made this comment to share a method of engaging the students in an activity, "One of my professors suggested always using the students' names because they get more involved if they see some connection" (Group Meeting 1, 3/1/07). The participants seemed to rely on the resources available at their schools and from conversations and observations it is difficult to say whether the school environment created the extent of involvement or whether the participants determined how exactly to use the resources.

The participants' comments are consistent with research conducted by Teacher Policy Research. As I stated in Chapter 2, Teacher Policy Research (Boyd, et al., 2005) found that teachers through alternative pathways in their first year do not teach mathematics or English Language Arts as well as teachers who have gone through the "College Recommended" path. This may be true based on standardized tests, but in the classroom they largely depend on the curriculum as written. Julia, who is a first-year teacher, seemed to be less dependent on the lesson plans of *Everyday Mathematics* (2004), but I and even she would say that this is because she doesn't spend much time preparing for her lessons and *Everyday Mathematics* depends on thorough preparation with lots of manipulatives. However, what we have learned about James and his manner in accessing resources may not be attributed to the path he has taken into teaching, but more on his school environment. As he stated in several group meetings, his math coach and math specialist are both very good, and there is a lot of structure. As mentioned, the pacing calendar was reconfigured to emphasize topics for the assessments in March and move other topics to be taught after the assessments.

Summary

The purpose of this study was to create a description of the effect of teacher identity, reflection, and practice on the teaching of mathematics through the use of a community of practice. The community of practice was an opportunity for the teachers to come together to reflect on teaching, discuss mathematics, mathematics teaching, and the policies affecting them. This occurred over the course of four meetings in various ways. Through watching the video clips the teachers were able to reflect on their teaching, but as was reported in the findings, more time for the study would have produced better tools (i.e. examples of students mathematical thinking) for the participants to employ for reflection. They were just starting to look at the students and mathematical content in relation to their teaching. Through doing some problem solving and watching the video clips, they were able to discuss mathematics and mathematics teaching. These discussions were helpful in obtaining a better picture about how the teachers thought of mathematics and mathematics teaching, but the concrete knowledge transfer was limited. And finally, through the use of specific agenda items, they were able to discuss the policies that affected them. The community of practice enabled the teachers to build that community in which learning occurred and identities were transformed, as they had some commonalities to build from and a shared vision of learning to work with in the structures of the urban schools. This community of practice gave the participants a place to share their issues and problems in a way that they might not have been available elsewhere. Julia noted in a final write up, "I wish this type of professional conversation could continue" (Group Meeting 4, 5/29/07).

A couple of critiques of this study are important to mention. Time was definitely a factor. The participants in this community of practice would probably have benefited from meeting over a longer period of time. Though this research study was very valuable to all the participants involved, it became clear that a larger and more structured group meeting may have given the participants more information; for example, Jessica commented that she wished that there were more people in the study to add to the beneficial information and ideas that were exchanged (Group Meeting 4, 5/29/07). Though it wasn't expressed by the participants, a greater emphasis on other forms of communication might have been helpful. The participants took it upon themselves to continue the conversation over e-mail with me but possibly discussing issues, lessons, and students with each other over e-mail during the course of the study would have been an added bonus to the community.

Conclusions

This study shows that the impact of communities of practice on the learning and development of new elementary school teachers is a model for induction and professional development that should be further explored. For the participants in this study, communities of practice had a positive affect on their learning and development. Communities of practice dealing with reflection and inquiry increased these new teachers' confidence and competence with mathematics and their willingness and ability to access resources. This study had the limitations of a short time frame, few participants, and participants who volunteered and were predisposed to improve their teaching of mathematics. Even with these limitations, this study seems to indicate that

continual learning is supported by the involvement in a community of practice and working with a mentor on a regular basis. It is important to note that how a new teacher grows and develops as a teacher of mathematics is contingent on the influences of the teacher's school policies, the professional development they are involved in, as well as the teacher's identity as a mathematics teacher. While case studies such as these can give us important leads, additional large-scale research is needed to confirm the findings. It should be noted, however, that many research studies and syntheses of research have led to the same conclusions (Ingersoll and Smith, 2004; NCTAF, 2005; New Teacher Project@UCSC, 2006). These studies, both quantitative and longitudinal, support the use of communities of practice, inquiry, and learning communities. What we have in this study is the actual and personal experiences of teachers beginning to teach in an urban setting.

I hope this research will lead policy makers to examine mentoring carefully to see which benefits of a community of practice can be replicated. There is evidence, including in New York City, that moving away from systematic mentoring in the face of budget deficits may have prevailed. Most important, the benefits of collaboration among teachers is found to be a valuable asset for in-service teachers, especially new teachers, and should be used to help them transition into the profession. This transition, as studies have shown, is likely to have positive impacts on retaining teachers in the profession (Ingersoll and Smith, 2004; NCTAF, 2005).

Some suggestions for future research could take the model of mentoring in the form of a community of practice and carry it out on a larger scale to see the effects in an

urban setting. Furthermore, a longitudinal study could be conducted to demonstrate in greater depths the impact of this type of induction for new elementary school teacher.

Final Thoughts

The participants were given the opportunity to be involved in a study to reflect on their teaching through the use of video recordings, to interact with fellow elementary school teachers in a new way, and to ponder questions they may not have otherwise considered. Some e-mail messages that the participants sent after the study concluded may say more than anything else about the impact of this kind of professional development.

The first message is from Julia (June 2007).

> Hi Laura,
>
> I just recently started taking my math class, and I had some relevant thoughts I might share with you.
>
> The professor is a bit haphazard, but I am enjoying the material. So far, we've gone thorough all of the divisibility rules and "discovered" why they work. We've done a lot of experimenting with the way numbers work and it has really forced me to look and number from all different angles.
>
> I had a discussion with some of my classmates afterwards. Most of them shared the sentiment that *"Everyday Math* is crap" and the conceptual understanding of math is a waste of time for most students. They were frustrated with the professor, who went through all of the divisibility rules and challenged us to defend why these rules exist and really figure them out. Several of these teachers were early

elementary school teachers, who felt that the material was irrelevant to their teaching. I had a very different opinion, and a lot of this has to do with my developed understanding of mathematics, which I can attribute to my participation in your research project. I found myself defending mathematics and why students need to prove why they get an answer, and why it's important to teach partial sums addition, etc. Most of them argued that the divisibility rules are just memory gimmicks and students should just actually divide a number to find out whether it's divisible by 3 or not. (In other words, it's a cop out for long division.) It's funny, because I think when I taught the divisibility rules unit in October, I shared this sentiment, but after having really 'tackled' math this year, I have a better understanding of why I teach what I teach. Today it really clicked for me in class, and I saw that these rules are not just tricks, but really have to do with the way numbers work, and challenge us to look at numbers in a different way.

So, thank you again. I'm really realizing how much better equipped I feel in regards to being a math teacher.

Take care-Julia

In a second e-mail message from Julia during the summer, she commented on her rewatching of the videos and said, "I really found it helpful and I'm so glad that I have them to refer back to, for both the good and the bad" (E-mail Correspondence 9/5/07).

And finally an e-mail from James during his third year of teaching. Before this e-mail, James has continued to ask me questions and to ask for advice about teaching. He had a formal observation coming up and wanted some advice on how best to teach a probability lesson. It is interesting that he is basically following the written curriculum:

> "Well here's my lesson plan. Like I said, I basically took it from the book. 8.2 can be found in the Third Grade Teacher's Manual Volume 2" (e-mail message 4/8/08).

Here is his response after I wrote him some suggestions on how to modify his lesson and take into account some difficulties that might arise with his students during the teaching of the lesson.

> Wow Laura, that was wonderful! Your ideas are above and beyond what I expected. Thank you so much! The reflection idea is also a good thought. I'll send it to you on Monday night so you can reflect on my reflection. I feel so much better now that I have these modifications. I'll digest them further over the weekend and look forward to the lesson on Monday.
>
> Thanks again, James (e-mail message, 4/10/08)

Reflection, conversation, and mentoring/support can make an enormous difference in how teachers focus on their work and see themselves in the context of teaching mathematics. The evidence that communities of practice can in fact add to these qualities that are so important suggest that an investment in such communities will be most worthwhile.

Epilogue. In communicating with the participants throughout the year following the study and beyond, it became apparent that they continued to appreciate their involvement in the study. What follows is a brief update of each of the participants in regards to their teaching. It is important to note that one cannot attribute these positive updates to the involvement in this study.

James is currently in his fourth year of teaching at the same school at which he started. He is continuing to pursue his master's degree and has stated that he is in the "home-stretch." He is teaching third grade. One of the things he mentioned in an e-mail correspondence was how he has increased his involvement with other teachers in his school in regards to mathematics teaching. Julia is in her third year of teaching at the same school at which she started. She has finished her master's degree and is already thinking about pursuing a more advanced degree in the field of education. At her school, she has been asked to help new teachers acclimate to the community. Jessica is in her third year of teaching at the same school at which she started but is now teaching fourth grade. She has completed her master's degree in childhood education and she is excited about teaching a new grade level. Moreover, she was intrigued at the prospect of teaching some of the same students that she taught in the previous year. These teachers have continued to remain in the profession. Remaining in the profession, taking on leadership roles, and a continued enthusiasm and excitement are more evidence that communities of practice can add to these qualities in teachers.

Appendix A

Agendas for Group Meetings

Meeting Agenda March 1, 2007

1. Reintroduce myself, the researcher
   - What the study is
   - My expectations for the group meetings
   - Their expectations
   - Nothing is set in stone

2. Start the meeting with postcard introduction
   - Pick a card which shows how you feel about mathematics?
   - Pick a card which shows how you see mathematics teachers?

   Discussion of why you picked the cards
   - State your name
   - Grade you teach
   - What type of school you are at and how you found your school
   - Discuss why you picked the cards

3. Discuss how most meetings will progress and that I am open to suggestions from them about topics they want to talk about.

4. Show clips of the three teachers have participants watch and comment as we go through the clips
   - Julia – integers
   - Jessica – parallel lines
   - James – fraction word problems

SKIP DISCUSSION OF RESOURCES TILL NEXT MEETING

5. Final part – do a brief free-write on WHAT IS A MATHEMATICS TEACHER? WHAT IS THE MATHEMATICS TEACHER'S ROLE?

   Discuss what is written.

6. Give opportunity for participants to comment on what they would like from the meetings.

Meeting Agenda March 29, 2007

Intro: Discuss NCTM conference – publications, session I went to about incorporating literature into the math lessons – give the suggested bibliography
How to become a member.

1. Begin with the clips

   Discussion of the content presented and Everyday Math

   a. Jessica - Clip comes from 3/12 lesson on Number Model with Parentheses Unit 7.4 Third Grade.

   b. Julia - Clip comes from 3/9 lesson on Volume of Rectangular Prisms Unit 9.8 Fifth Grade.

   c. James – Clip comes from 3/1 lesson on Parallel and Intersecting Line Segments, Rays and Lines. Unit 6.2 Third Grade.

   <u>Discussion Topics regarding the Clips:</u>

   Looking at these three clips –
   What comments do you have about the Everyday Math Program?
   What comments do you have about the NY State Standards?

   Additional Comments?

2. Pull out 2 units in Everyday Math
   i. For Third Grade use 2.7 (The Partial Sums Algorithm) and 2.8 (The Trade-First Algorithm)
   ii. For Fifth Grade use 3.3 (Exploring Angle Measures) and 3.4 (Using a Protractor)

   I chose these four units because of how the 3rd grade one builds to the many different algorithms and facility the students will have with addition by 5th grade and how the 5th grade one is an extension on the measuring angles that is done in 3rd grade. Also looking at the NYCDoE pacing calendars may lead to further discussions about what is expected/organization/etc.

   a. Discuss layout of the lesson
   b. Organization
   c. Relationship to pacing calendar
   d. Expectation by ?

3. Quick Free-write:
   a. If you had the freedom to write a lesson on measurement in relation to distance – what would you stress and why would you stress it?
      Write this in relation to the grade you teach.

Meeting Agenda May 10, 2007

1. Start off as they come in playing "Petals Around the Rose" – I need 5 die.

Once they all have figured it out or after 5 minutes of play:

Stop the game and leave till end of the meeting

Or

Discuss problem solving techniques – simpler problem – why 5 die

- Keeping track of turns in a table
- Writing down what we know
- Using solvers to run "PATR"

Give them the problem of the week and the website www.mathforum.org (lost funding so need to pay for membership now – you can do a trial 21 day membership to try it out.)

Are We There Yet?

With summer winding down, Mr. and Mrs. Mallery decided to take their family to the beach one last time. They loaded their kids, Olivia and Liam, into the car and headed off early in the morning.

At 7:05 am Olivia asked, "Are we there yet?"

"We're one-third of the way there," replied Mr. Mallery

At 7:25 Liam asked, "Are we there yet?"

"We're 75% of the way there," said Mrs. Mallery. "Now, can you two figure out what time we should get to the beach?"

Can you help Olivia and Liam determine what time they will arrive?

Discuss problem solving techniques – What do you expect your students to do? And Why?

2. Clips - Discussion of the content presented and Everyday Math

Jessica – Using chips to discuss fractional parts.

Julia– The derivation of $A = \pi r^2$

James – Use of arrows in mental multiplication – show students doing the same.

Discussion Topics regarding the Clips:

Looking at these clips – why are we teaching what we are teaching – When and for what purpose?

Additional Comments?

3. Following up on Last Meeting

We looked at specific lessons and the pacing calendar and discussed the relationship between Everyday Math and the Pacing Calendar and your teaching

Now lets approach these questions - Overall Discussion Questions:
Is there an intellectual reason for arranging the program in this way?
What might be the purposes for the arrangement?
What pressures may influence the choices that are made in your classroom or in your School?

4. Finally – let's talk about the math coaches that you have access to

Free-write on

How and in what ways, if any, is your math coach helpful and what about the program would you change

Discuss free write.

Meeting Agenda May 29, 2007

1. Look at Pacing Calendars for the fifth and third grades.
   - Do they make sense in relation to the lessons that you taught this year?
   - How do you feel about the pacing calendars in relation to your teaching?
   - How do you feel about the pacing calendars in relation to mathematics?
   - Is there an intellectual reason for arranging the program in this way?
   - What might be the purposes for the arrangement?
   - What pressures may influence the choices that are made in your classroom or in your school?

2. Clips – these clips were not chosen for content - I just picked three 5 minute clips for each of you.

   I want you to be critical of what you see
   Look at students, curriculum, classroom, the teacher, make suggestions.
   Take your time – it may be hard to think of constructive criticism on such short clips.

Discussion: How does the mathematics feed into your comments?
How does the school feed into your comments?
How do the students feed into your comments?
Let's relate these comments to your reflections over the course of the study.

3. Communities of Practice

Let's talk about the difficulties and the benefits of meeting with teachers in relation to being a teacher.
How does constructive criticism and compliments play a part in the interactions.
How would your colleagues respond to establishing a community of inquiry?
How would your principal respond?
What is the likelihood you would pursue such an arrangement in your setting?

4. Free-write on

What do you like about being part of this research project?

What do you dislike or would you change about being part of this research project?

Discuss free write.

Hope for future contact with one another and with me.

APPENDIX B

Letter to Teachers

December 22, 2006

Dear Brooklyn College Student or Alumnus in Education,

Hello, my name is Laura Gellert and I am a doctoral student in the Urban Education Ph.D. Program at The Graduate Center of the City University of New York (CUNY). You were recommended by Brooklyn College as a possible participant in a research study. I am conducting this study (with guidance from Dr. Laurel Cooley, Mathematics Dept, Brooklyn College) entitled "A Descriptive Interpretation of First-Year Elementary Teachers and their Teaching of Mathematics." I am looking for participants for this study who match the following criteria: Elementary teachers who are in their first year of teaching and who teach in grades 3, 4 or 5. In addition, participants need to have completed initial certification and be teachers in the New York City public school system.

The goal of this research project is to build a rewarding mathematics learning community for a small group of elementary public school teachers so that they may learn and reflect on their own math teaching practices. We hope to find a group of dynamic teachers who are interested in learning more about math and ways in which it can be taught to elementary children. I hope you will consider joining us.

Please note that all participants will be compensated for their time (see below for specifics). The research itself would include observations by me of each of the teachers during their mathematics lessons. In addition, the participants would keep a journal detailing their perspective of the observed lessons. The journal and the observation would then be used during a group discussion with three other first-year elementary teachers. This group would give participants the opportunity to be involved in the learning and reflection about teaching elementary mathematics.

The group discussions will occur once a month for about 4 months and will meet for 2 hours. These meetings will occur either at Brooklyn College or at the Graduate Center of CUNY (365 Fifth Avenue between 34th and 35th Streets) depending on what is most convenient. Observations would occur twice a month, between meetings. The day and time of meetings will be set to accommodate participants' schedules. Each participating teacher will receive a stipend of $75 per meeting. I would like to begin the meetings as soon as possible.

Please note that I have been a mathematics teacher for over 10 years in grades 4 – 12. I completed both an undergraduate degree and a master's degree in pure math. I love to teach and I am very interested in elementary mathematics teaching because I believe it is the best opportunity to give kids an exciting math experience. I believe that I could be an asset and resource for the teachers in this group.

If you have any questions about this research and/or you are interested in participating, you can contact me at 917-405-4734 or lgellert@gc.cuny.edu. I ask that if you are interested that you please contact me as soon as possible, and no later than January 22nd, so that we may formulate the group.

Thank you very much for your consideration.

Kind regards,

Laura Gellert

Appendix C

Example of Coding

This example of coding is taken from the dialogue during group meeting 1 after watching a video clip of Julia's mathematics lesson involving addition and subtraction of integers. In this lesson students modeled the addition and subtraction of integers by walking along a number line. After watching the video the participants began their discussion. The dialogue was transcribed and then coded.

Group Meeting 1	I statements	They Statements	CCM	Everyday math	policies	Identity	Other	student behavior	Influenc of study	
Video Clip of Julia	I thought it was -7 - james									
	I'm sure it was -julia	They're teachin it wrong (everyday math) - James		I really like the game - Jessica						
			Do you do it with paratheses? James (asking a mathematical content question)	It was everyday math - Julia						
	It is a confusing thing and part of the reason was I ..I tripped up and I felt like I had Adrian up on the board for way to long but I think it was because I wasn't secure in the method. I was like let me do one more example so that I get this And maybe that is why I had michael come up to the board because I need more examples			But you used it - LG - need for a confidence booster						
			James makes the suggestion of having the modeling of what they are doing when they are walking initially written down				Interruptions = it is challenging to work with -LG			
							I thought that was just like part of our job and you just got to deal with it professionally - James			

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