TEACHER OPPORTUNITIES TO LEARN: RESPONSES AND

RECOMMENDATIONS OF GRADES 6-12 MATHEMATICS TEACHERS

FROM ONE DISTRICT

A Dissertation

Presented to

the Faculty of the Graduate School

University of Missouri

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

by

AINA K. APPOVA

Dr. Fran Arbaugh, Dissertation Supervisor

DECEMBER 2009

The undersigned, appointed by the dean of the Graduate School, have examined the

dissertation entitled

TEACHER OPPORTUNITIES TO LEARN:
RESPONSES AND RECOMMENDATIONS OF GRADES 6-12 MATHEMATICS
TEACHERS FROM ONE DISTRICT

presented by Aina K. Appova,

a candidate for the degree of Doctor of Philosophy,

and hereby certify that, in their opinion, it is worthy of acceptance.

_____
Professor Fran Arbaugh

_____
Professor John Lannin

_____
Professor Kathryn Chval

_____
Professor Jessica Summers

_____
Professor Jay Scribner

Я посвещаю эту работу моим дорогим и любимым родителям: Эмма и Какабай

ACKNOWLEDGEMENTS

First and foremost, I would like to express my deepest gratitude to the dissertation committee: Dr. Fran Arbaugh, Dr. John Lannin, Dr. Kathryn Chval, Dr. Jay Scribner, and Dr. Jessica Summers. Thank you for agreeing to guide me through this challenging learning experience. I specially thank Dr. Fran Arbaugh, my advisor, for her unwavering support, supervision, patience, and enthusiasm throughout all these years. Without her, my academic achievements would have been futile. I thank Dr. Kathryn Chval and Dr. John Lannin for making me a better learner and for always answering my questions with another question. I thank Dr. Jay Scribner and Dr. Jessica Summers for opening my research horizons to "see" beyond mathematics education. I thank all of you for setting an example of true mentorship supporting and advising me in difficult decisions throughout my academic and professional career. It was an honor working with you.

Furthermore, I am thankful to the rest of the mathematics education faculty for providing an excellent support and supervision throughout my program. I thank the graduate students for providing an atmosphere of camaraderie and friendship. I also thank Dr. Barbara Garii and Dr.Azita Manouchehri for their continuous dedication and participation in my academic achievements. Thanks for always standing by, ready to help. I would like to thank all of my friends and family, especially my sisters, who helped and cheered for me through these intense years of graduate school. Most importantly, I want to thank my loving parents for always believing in me and supporting me throughout my life. I dedicate this work to you, mama and papa. I love you very much.

TABLE OF CONTENTS

LIST OF FIGURES

ABSTRACT

This is a case study of one district, examining secondary mathematics teachers' perceptions of professional learning and teacher professional development. Research questions include: a) Why did the teachers from this district want to learn professionally? b) What did they want to learn? and c) How did these teachers want to learn? Mainly qualitative, and some quantitative, data was used for this project. Participants included thirty-five grades 6-12 mathematics teachers with different teaching backgrounds (representing eight schools), and one mathematics district coordinator. The findings suggest that teacher learning is largely dependent on the contexts within which teachers are situated. All teachers engaged in professional learning, including those who did not attend district-sponsored professional development. Teachers were found to be motivated to learn for three reasons: student learning and advancement, teacher career advancement and promotion, and the district requirement for learning. Moreover, novice and experienced teacher needs differed significantly. However, most of the teachers described effective professional development within eight mathematics topics: content, curriculum, assessment, student learning, instructional strategies, classroom management, teaching philosophies, and technology. Teachers described working with other mathematics teachers in the building as the most effective learning opportunity. Opportunities for common lesson planning and reflections, teacher community learning, and sharing of instructional ideas were emphasized strongly by all teachers. Discussion includes connections between teacher learning, teacher motivation, and educational policy research. Implications for Teacher Education research have also been provided.

CHAPTER 1: BACKGROUND AND STATEMENT OF THE PROBLEM

Statement of the Problem

Over the past several decades, teacher learning and teacher professional development have taken on different images, structures, and purposes, always trying to focus and address educational concerns and political agendas. Historically, teacher professional development has taken place in isolation and has been dependent upon input from outside ''experts'' (Sandholtz, 1999). As a profession, teaching has often been described as highly individualistic, where the decision-making was isolated and problem solving and collaboration with peers was limited (Lortie, 1975). Many inservice learning experiences, especially those in the form of classes, lectures, and presentations, were found to be inadequate in their relevancy and often left teachers in an isolated position as well (Hargreaves, 1992).

One of the major limitations of traditional models of professional development has been the passive role imposed upon teachers, who find it difficult to implement ideas that are often conceptually and practically far removed from their classrooms. Specifically, professional development opportunities were often found to be limited in the degree to which teachers worked and learned actively and collaboratively (Burbank & Kauchak, 2003).

In the past forty years, the demands and requirements imposed on the teachers and on the teaching profession have been rapidly changing and increasing. In the 1960's – 1970's, with the increase of high school mathematics courses and political competition in the international science and mathematics race, teachers continually struggled with professional development especially in increasing their subject matter knowledge.

Normally, to meet these requirements, teachers were mandated to enroll in more mathematics courses (American Mathematical Society, 2001), which often were taught devoid of classroom applications and relevance, and were inattentive to the mathematical learning needs of the teachers.

By the end of 1980's, a new series of expectations and requirements were forth set for teachers, following the publication of *An Agenda for Action* and the *Standards* (National Council of Teachers of Mathematics [NCTM], 1989). Teacher learning changed its course of action to address teacher professional learning needs related to the classroom implementation of the *Standards* (NCTM, 1989) and newly developed *Standards*-based curricular materials.

The NCTM *Standards* and new curricular materials sparked much attention related to mathematics teaching and learning, and were fundamentally different in their mathematical and pedagogical underpinnings. *Standards*-based teaching required teachers to "open up their classrooms for discourse about mathematical ideas and their meanings, use instructional tools to enhance learning, strengthen students' understanding, and provide a challenging, but nurturing, classroom environment" (NCTM, 1991). Classroom implementation of new curricular materials required teachers to know and understand mathematics conceptually, to perceive students as learners, and to use effective pedagogical strategies that offered a challenging and supportive classroom learning environment (NCTM, 2000). All of these expectations were a novelty and an educational revolution to the vast majority of mathematics teachers, and consequently resulted in many of them struggling to teach to the new *Standards* and to use the

Standards-based curricular materials (e.g., Ball, 1995; Manouchehri, & Goodman, 1998; Remillard, 1996).

Consequently, teacher development was essential and required for enactment of the reform, and most of all, for continued teacher learning:

> Without professional development, school reform will not happen. . . . The nation can adopt rigorous standards, set forth a visionary scenario, compile the best research about how students learn, change the nature of textbooks and assessment, promote teaching strategies that have been successful with a wide range of students, and change all the other elements involved in systemic reform. But, unless the classroom teacher understands and is committed to the plan and knows how to make it happen, the dream will come to naught. (Darling-Hammond & Sykes, 1999, 1–2)

By the end of 1990's, the focus of professional development was restructured from one-shot workshops and distant institutes to school-based teacher collaborations and university faculty partnerships. Professional developers and teacher educators were specifically focused on the issues of: a) changing or reshaping teachers' deep-seated beliefs about student learning and teaching, in particular, their conceptions of knowledge as facts, teaching as telling, and learning as memorizing (Ball, 1996; Darling-Hammond and Ball, 1998); b) teachers' lack of subject matter knowledge (Loucks-Horsley, 1999, p. 262); and c) teachers' knowledge about students, their ideas and ways of thinking (Fennema et al., 1996; Schifter, 1996). Models of professional development such as lesson study, peer observations, and study groups gained recognition in the 1990's. The contexts of professional development changed as well, relocating teacher learning into their own schools and classrooms, and bringing teachers together in communities of learners.

During the last decade, increased numbers of educators began to encourage reflectivity as an essential element of teaching and teacher development (Bullough &

Gitlin, 1995; Norman, Sprinthall, & Thies-Sprinthall, 1996). Various methodologies were designed to promote reflection and to persuade teachers to become consumers of research, participate in research discussions, and develop research-based approaches to classroom decision-making (Cochran-Smith & Lytle, 1992; Zeichner, 1994).

However, a great deal of teacher learning was focused on addressing political and educational agendas instead of attending to teacher professional and learning needs. In addition to the NCTM Standards the *No Child Left Behind Act* (U.S. Department of Education, 2001) was endorsed, which required every teacher to be highly qualified, every student to be mathematically proficient, and every school to be academically well performing. As a result, more than 40 states adopted standards calling for "effective" professional development for all educators accountable for results in student learning. The national government spending on teacher professional development, especially in the areas of science and mathematics, reached more than $3 billion dollars (Wei et al., 2009). This legislation required states to classify schools based on students' performance on national and state academic assessments; student performance data became the driving force of teacher professional development. Many states and districts began to incorporate student performance data into the teacher professional development, mandated teachers to attend district-sponsored professional development, and made state assessments and students' achievement levels available via the Internet and other media as public information (Zambo & Zambo, 2008). Consequently, the nature of teacher learning yet again regressed to become "one-shot workshops" (Garet et al., 2001), often focused on management, discipline, and administrative concerns rather than on the subject matter knowledge and the content-specific pedagogies (Desimone, et al., 2002). Unquestionably,

in the midst of these demands, teachers' needs for professional development were not a priority and continued to be ignored.

Meanwhile, research studies continue to document challenges with regard to teacher learning. Many teachers, even with professional development, are still unable to successfully implement the *Standards-based* curricular materials, many districts stopped using the *Standards-based* programs, and many other districts are using the *Standards-based* curricular programs to supplement their traditional lectures (Remillard, 2000).

Moreover, recent findings suggest that teacher participation in professional development had also declined in the past few years (Wei et al., 2009). Scribner (1999) found that teachers rated professional development (e.g. workshops, conferences, in-services) to be of little usefulness to their careers and teaching practices. Teacher disengagement and disinterest in professional development is becoming a widely discernible concern across the country (Sowder, 2007). Some teacher educators suggest that, partially, teachers are becoming apathetic to learning due to the rapid and persistent systemic and political changes and school reforms (see Berends, Chun, Schuyler, Stockly, & Briggs, 2002; Clune, 1998;; Desimone, 2002). Others, however, argue that the inability of professional learning opportunities to truly meet teachers' needs ensures teachers' dissatisfaction with professional development (Ball & Cohen, 1999; Cohen & Hill, 1997; Little, 1994; Lord, 1994; Miles, 1995).

Today, little evidence exists about *why* teachers' needs are not met, *what* those needs might be, and *why* teachers do not feel satisfied with professional development. As a result, research claims and implications strongly suggest that further research on teacher learning and professional development is needed in order to better understand teachers'

learning needs and help them not only become successful, competent, and knowledgeable

with the *Standards-Based* instruction, but to also be well-prepared to engage and

implement the school reforms and the systemic changes (Sowder, 2007).

Ball and Cohen (1999) argued that because teachers need to become serious

learners of teaching and practice rather than learners of strategies and methods offered in

a "one-shot workshop," the problem within teacher education lies more subtly in the lack

of research about *what* teachers need to learn and *how* they can do so the best. It is

fundamental to consider not only the learning opportunities that "immunize teachers

against the conservative lessons that most learn from practice" (Ball & Cohen, 1999, p.

6), but also professional development opportunities in which teachers are presented with

elements that coherently support acquisition of new knowledge, skills, and dispositions

that enable teachers to encourage their own learning (Ball & Cohen, 1999). These authors

also argue that even though the research database on "effective" professional

development is considerable, it is mostly grounded on the views of teacher educators and

professional developers. To "reach" more teachers, teacher education research must

include a new focus; rather than asking the question "How might we help more teachers

implement the reform?" research must consider aspects of motivating and engaging

teachers in developing and enacting the reform (Ball, 1995, p. 500).

In agreement with these statements, the National Staff Development Council

recently published *Professional Learning in the Learning Profession* (Wei, et al., 2009) -

a status report on teacher professional development in the United States and abroad. In

the opening statement of this document, the authors wrote:

> Several national studies on what distinguishes high-performing, high-poverty
> schools from their lower-performing counterparts consistently identify effective

school-wide collaborative professional learning as critical to the school's success. And yet as a nation we have failed to leverage this support and these examples to ensure that every educator and every student benefits from highly effective professional learning. (p. ii)

Furthermore, recent research studies suggest that professional development models should no longer be designed devoid of teacher input in regards to professional learning. Through the analysis of teacher conversations and written work, Arbaugh (2003) argued that professional study-group meetings had a direct impact on teacher learning and increased their professional confidence as a result of the collaboration and communication. She also concluded, "Listening to what teachers tell us about their motivation for learning is vital for understanding in-service teacher education issues" (p. 141).

Ball (1995) suggested, "We know little about how teachers develop the personal qualities important to more complex forms of teaching – qualities such as courage, confidence, and curiosity" (p. 45). In addition, Klassen and Short (1992) stated: "Few research studies look at how beliefs and practices are developed, shifted, and changed and what contexts and conditions exist to promote or inhibit those changes" (p. 343). Hence, teacher education is in critical need of research on teacher learning, especially in regard to teacher professional learning needs, how teachers develop dissatisfaction with professional development, and why some teachers develop the desire to learn and experiment with *Standards-based* teaching while some do not. Until we have answers to many of these questions, professional development will continue to be "preaching to the choir," serving only those few who diligently attended all these years, but leaving behind many teachers who we know very little about, especially in regards to their learning and professional development needs (Ball, 1997).

Purpose of the Study

The purpose of this research study was twofold. First, I investigated mathematics teacher learning and professional development from one district by gaining their personal insights and perceptions about characteristics and components of the professional development opportunities they have found effective, helpful, and successful. Second, I investigated important relationships between teacher learning and teacher professional development experiences and outcomes of this particular district, as suggested by Guskey and Sparks (1996).

Guskey and Sparks (1996) suggested that important relationships exist among the nature and the structure of the professional development and teacher learning outcomes, and described the nature of teacher learning as a compilation of four clusters: 1) what is to be learned (content); 2) how the content is to be learned (process); 3) how the content is organized or presented for learning (strategies and structures of professional development); and 4) the environment or conditions under which the content is learned (context).

Thus, the overall purpose of this study was to investigate and collect empirical evidence related to the nature (and the four clusters) of teacher learning, and to gain teachers' insights about specific characteristics of effective professional development.

Justification for the Study

Teacher learning and teacher professional development served as the main focus of this study. The design and methods of the study were primarily centered on gaining insights, ideas, suggestions, and evocations about professional learning experiences and

effective professional development from the teachers themselves. The reason for which I chose this particular focus is simple. Scarce research is available on the nature and characteristics of teacher learning, especially related to teacher professional learning gaining the insights from the teachers themselves. However, the need for this research is colossal. In fact, Guskey and Sparks (1996) proposed that student learning outcomes are improved largely through a variety of complex relationships between quality staff development and the knowledge and practices of teachers, as well as administrators and parents. The authors also concluded that to be able to establish a clear link between teacher quality and improved student learning, a substantial research and evaluation of teacher learning and teacher quality is required, in addition to examining these relationships and their interactions as a result of professional development.

Second, the majority of research on teacher learning is focused on effectiveness of professional development, focusing on teacher engagement, participation, attendance, of the professional development, leaving behind the successful models and structures that support and encourage teacher learning (Loucks-Horsely, 1999).

Third, in regards to the outcomes of teacher learning, from the perspective of districts and states, teacher learning is often expected in a form of compliance rather than professional growth. Districts and states "do not evaluate the connection between the dollars they spend, the programs they purchase, and results they get" (ECS, 1997, p. 7). Moreover, Loucks-Horsely (1999) argued:

> In the push to implement both content and student performance standards, it is apparent that teacher learning is critical in helping instruction move beyond mechanistic implementation to maximize student learning. Exactly what teachers need to know to do so, and how they need to learn, are critical pieces of the picture that results in student learning. (p. 262)

Traditionally, the goal of professional development largely has been focused on increasing student achievement. In fact, there were many who believed that the funds allocated to professional development are not worthwhile investments unless targeted specifically toward improving student achievement (Dozier, 1998; Education Commission of the States, 1997). However, after numerous years of developing "effective" models of professional development, teacher education research concluded that teacher learning is multipurpose and complex. In particular, teacher learning involves growth of teachers as individuals, as a group or collective, and most importantly, as an educational system that is intricate, dynamic, and full of cultural and intellectual contexts that are uniquely constrained (Krainer, 2001). Thus, teacher professional development must entail teacher advancement and learning as a means for improving student achievement.

Effective professional development is becoming increasingly important to both educational administrators and political officials. On one hand it is important due to the government spending of billions of dollars on offering effective professional development to the teachers. On the other hand, effective professional development is needed for realization of mathematics education reform and the advancement of student mathematical knowledge and achievement (Darling-Hammond & Sykes, 1999; Sowder, 2007). These goals are ambitious and not easy to achieve. They require a great deal of change in teaching and learning, instructional practices, and most of all, change in the nature of the way the content and pedagogy are learned and perceived by teachers.

The general principle is that educational change mostly occurs as a result of teacher professional development, where change in teacher knowledge and beliefs "either

precede or develop simultaneously with changes in teacher behavior" (Cooney, 2001, p.

18). However, Cooney also argued that many teachers do not see the need for a change,

thus do not see the need to learn. And even if they do, having a reason to change or learn

does not always guarantee making a change or engage in learning. Yet, very little is

known about *why* teachers close their eyes on the educational reforms and changes, and

why they choose not to learn or not to engage in learning.

On the contrary, there are many who believe that teachers do not engage in

learning because they are continually dissatisfied with the professional development and

that it does not meet their learning and professional needs. In the *Professional Learning*

in the Learning Profession, Wei and colleagues (2009) argue that teachers, especially the

ones who are not seeing the need to change or learn, are not suffering from learning

lethargy, but, most likely, are not satisfied with professional learning opportunities

available to them. Additionally, they argue that perhaps the teachers are not satisfied with

the learning environment at their schools and the district, and maybe carry perceptions of

their low levels of influence on school policies and district decision making:

> The low ratings of the usefulness of most professional development activities and
> teachers' desire for further professional development on the content they teach,
> classroom management, teaching special needs students, and other topics, are
> indicators of the insufficiency of the professional development infrastructure now
> in place in most states and communities. The low levels of teachers' perceptions
> of their influence on school policies and low levels of agreement on cooperative
> effort and coordination among teachers are symptomatic of the lack of school
> governance structures and professional communities that involve teachers in
> collective decision making and problem-solving. (p. 61)

Similarly, Ball and Cohen (1999) suggested that true teacher learning and professional

development must account for teacher interests and needs, and support the acquisition of

teachers' knowledge and skills by allowing them to create their own learning. We must

redirect our research focus to include teachers' accounts of effective and successful learning, their motivation to learn, and critical factors that influence their learning and their engagement in learning. Moreover, we need to know more about *how* teachers develop their personal qualities such as courage, curiosity, and confidence, and most of all, *how* these personal qualities impact teacher professional learning and their motivation to learn (Ball, 1995).

Therefore, this study is critical and timely to the teacher education research. It is needed to better understand teacher professional learning needs and essential (to the teachers) characteristics of effective professional development. This study is critical and timely because it will shed further light on the educational inquiries about teacher motivation to learn, provide first-hand descriptions about various methods of teacher learning, and offer specific characteristics that teachers' define as effective professional learning models and experiences.

Research Questions

The research questions were posed and situated within the educational and policy context of one district, which served as a research site. In particular, the participating teachers were secondary (grades 6-12) mathematics teachers representing this district. The research questions were targeted to document this district's teachers' individual perceptions of professional learning. Thus, the research questions were specifically targeted to better understand these teachers' perceptions of professional learning within this particular district.

Guskey and Sparks (1996) suggested that an important relationship exists between quality professional development and various kinds of teacher learning outcomes, including student achievement. These authors described the quality and nature of teacher learning as four clusters: a) what is to be learned (content); b) how content is to be learned (process); c) how content is organized for learning (strategies and structures); and d) conditions under which content is learned (context).

As a result, in this study I sought to shed light on issues around these four clusters, mainly examining the quality and nature of teacher learning in one district regarding three central questions: *Why did secondary mathematics teachers in this particular district want to learn? What did secondary mathematics teachers in this particular district want (or need) to learn? How did secondary mathematics teachers in this particular district want to learn professionally?* Accordingly, to better understand specific aspects related to each of these questions, I specifically focused on the following:

- *Why did secondary mathematics teachers in this particular district want to learn?* This question includes teachers' perceptions and descriptions of the need for professional learning, including specific reasons for learning, factors that influenced their decisions regarding attendance and participation in professional development, and teachers' perceptions on the nature of their motivation to learn;

- *What did secondary mathematics teachers in this particular district want (or need) to learn?* This question includes teachers' perceptions about the types of knowledge and skills they need (or want) to learn professionally, including

specific professional needs of these teachers, and specific topics and subject

areas they wanted (or felt the need) to learn and advance.

- *How did secondary mathematics teachers in this particular district want to learn professionally?* This question includes teachers perceptions of their own learning as individuals and as part of the greater community (their schools and the district), including teachers' descriptions of helpful and useful learning experiences, examples of specific professional development models that they found effective, teachers' perceptions of what constitutes a "good" or "bad" professional development, and teachers' perceptions of "ideal" professional development and specific features that make professional development "ideal".

<center>Theoretical Framework</center>

For this study, I drew on a theoretical framework *How and What Teachers Learn* proposed by Shulman and Shulman (2004), which served two purposes for this study. First, I chose this framework to guide me in the design and data analyses of the study, framing my research questions and addressing these questions methodically and logically. Second, I chose this framework to guide my beliefs related to teacher learning and professional development within the framework of my research study, and help me better organize and understand the results of the study.

More specifically, in regards to framing and addressing my research questions, I utilized Shulman and Shulman (2004) framework (see Figure 1.1) in several ways. This framework represented concepts specifically related to *how* the teachers learned and *what*

the teachers learned in this particular district. The framework suggested that teacher learning is focused on four areas: vision, motivation, understanding, and practice. Consequently, I focused my interview questions, related to *what* teachers wanted to learn, to specifically mirror these four areas. I also used these four areas to guide the initial coding of my data. Additionally, Shulman and Shulman (2004) suggested that teacher learning is complex and occurs on individual, community, and policy levels. Consequently, when addressing the research question related to *how* the teachers in this district learned I specifically considered these three levels of learning.

In regard to this framework guiding my perceptions about teacher learning, I followed Shulman and Shulman (2004) suggestions and, ultimately, defined professional development as teacher learning opportunities, which may result in teachers gaining new information, improving knowledge and instructional practices, and as a result (in some cases immediately) advance student achievement and understanding.

Guskey and Sparks (1996) suggested that there are many factors outside the teachers themselves, their classrooms, and students that influence teacher learning. These factors include work conditions, contexts, and communities in teachers' home schools, districts, and states. I examined teacher learning as it occurred on multiple levels including at individual, community, and policy levels. Professional development can produce various teacher learning outcomes, including: a) *individual* teacher outcomes, such as teacher learning of new knowledge and teaching skills, changes in teachers' classroom practices; b) outcomes in teacher *community*, especially in creating professional learning communities, teacher leadership and collaboration, and school development and culture; and c) *policy* outcomes, such as enactment of the district-

adopted curriculum, development and evaluation of the curricular programs, and involvement in school and district policy changes. It is for these reasons I chose the theoretical framework of this study to mirror the recommendations of Shulman and Shulman (2004).

Shulman and Shulman (2004) proposed a shift in the perspective of teacher learning, calling for more expanded multi-level model that includes three major components: a) individual; b) community; and c) policy context or resources (Figure 1.1)
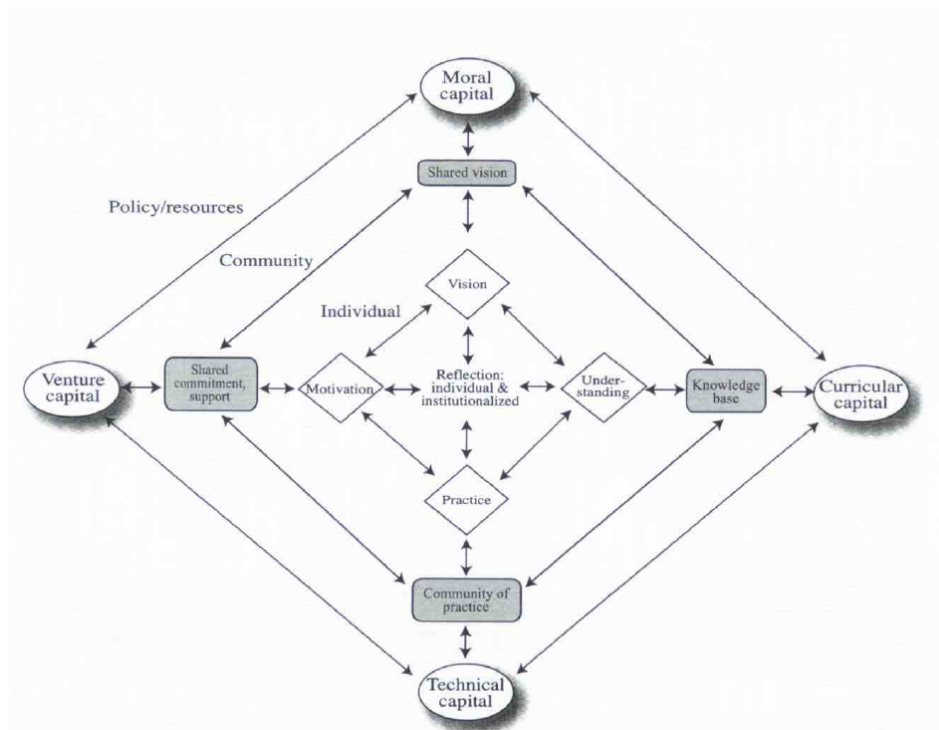
Figure 1.1 Model of Teacher Learning (Shulman & Shulman, 2004, p. 268)

Five central aspects are at the heart of the most inner polygon, the *individual* level of learning: a) teacher readiness, meaning that the teacher is ready to pursue a vision of classrooms or schools that constitute a particular approach to teaching and learning; b) teacher willingness, which encompasses teachers' determination or will to expend the energy and persistence to carry on the vision of classrooms or schools; c) teacher

16

knowledge, entailing the understanding of the concepts and principles necessary to achieve such teaching, and ability to "engage in the complex forms of pedagogical and organizational practice needed to transform their visions, motives, and understandings into a functioning, pragmatic reality" (p. 259); d) teacher reflection to learn from their own and others' experiences as reflective practitioners; and e) teacher membership in a community of learners, successful functioning in such communities, and being able to form similar learning communities at his/her work places.

Vygotsky (1978) suggested that we (as individuals) shape our culture and, in turn, our culture shapes us. Similarly, each teacher holds his or her own visions, motives, understandings, and capacities to practice and reflect; however, at the same time, every teacher is part of a community or communities (e.g., school, district, religion) that influence the development of teacher learning. Shulman and Shulman (2004) argued that earlier models of teacher learning were limited because they separated individual learning from learning within communities; however "the two dimensions are in continuing interaction and are mutually determining" (Shulman & Shulman, 2004, p. 265).

As a result, the second level in teacher learning model is a *communal* level representing the influences community has on individual teacher's learning and professional development. At this level, the *community* supports, hinders, or is neutral with respect to teachers' cooperative mutual reflections and accomplishments of particular learning goals through: a) common community visions or images about classroom contexts or teaching approaches; b) collective community commitments, support, and incentives; c) shared knowledge base, which may be common or a form of distributed expertise; and d) communities of established practices.

Since the *individual* and *community* levels are both interactive and independent, teacher educators must create learning opportunities and professional development contexts that support, sustain, and adapt the visions, understandings, performances, motivations, and reflection of *all* its members. Factors related to various *policy contexts* and the *resources* available for teacher professional development are fundamental for teacher learning. Effective teacher learning depends on having adequate resources such as, for example, mentoring, staff development, curriculum or curricular related materials, technology, models and instruments for assessment. Shulman & Shulman (2004) used the metaphor of "capital" to capture these resources in the model: a) *venture capital* represents the financial resources available for monetary incentives and supplies; b) *curricular capital* includes adequate curricular materials, faithful both to standards of learning and teaching, to support teachers' knowledge in the process of curriculum interpretations and adaptations; c) *cultural and moral capital* is directed at providing teachers with learning opportunities to achieve a common vision about teaching approaches; and d) *technical capital* is utilized to support and encourage teacher communities of practice.

Hence, according to this model, teacher learning can be viewed as a multi-leveled relationship among the vision, motivation, understanding, practice, and reflection of a learner and of the learning community. Moreover, teacher professional development heavily depends on supportive policy environment and resources available to schools and districts as indispensable elements of *all* reform efforts. Shulman and Shulman (2004) noted that in this model, "the learning proceeds most effectively if it is accompanied by

metacognitive awareness and analysis of one's own learning processes, and is supported by membership in a learning community" (p. 267).

Summary

The study of mathematics teachers' perceptions on professional development is both timely and imperative. For many years mathematics teachers' professional development has been focused on addressing political and educational reforms paying very little attention to the teachers, their career development, and teacher professional learning. However, research studies continue to document teacher failures to use *Standards*-based curricular materials, inability to implement reform instructional strategies, and incapacity to improve students' mathematical learning and achievement. On the other hand, teachers' disengagement and low rating of professional development opportunities is becoming a discernable concern across the country as well.

Some argue that, as a result of constant changes in the political and educational system, teachers have very little faith in reforms and perceive most of them as waves of experiments that come and go. On the other hand, several accounts have also been documented of professional development not meeting teachers' needs, suggesting that we need to better understand teachers' learning and professional needs to be able to create more effective opportunities for them to develop and grow professionally. Therefore, there is a critical need to examine and research teacher learning more closely. Specifically, more research is needed to better understand teachers' learning needs and ways to successfully address them through professional development opportunities.

Consequently, this study is focused on investigating and collecting empirical evidence related to the nature, quality, and characteristics of secondary mathematics teacher learning as a case study of one district. The goal of the research was to obtain the insights and suggestions about effective opportunities to learn from the mathematics teachers themselves. The research study is theoretically grounded in the recent framework proposed by Shulman and Shulman (2004), suggesting that teacher learning is focused on teacher motivation, understanding, practice, and vision about mathematics teaching, and it takes place within the various levels of individual, community, and policy contexts of teacher learning.

To provide more details on this theoretical framework, I continue this proposal in the next chapter, providing literature review related to both: the levels of teacher learning and each of the foci of teacher learning delineated by Shulman and Shulman (2004). Due to the construct of teacher learning being multi-faceted and cross-curricular, it was also necessary for me to consider and study the literature from other research areas outside of mathematics education, such as educational psychology (e.g., motivation theory, human learning, and efficacy) and educational policy (e.g., professional development policy, and effective models of professional development). As a result, I organized the next chapter into three major parts addressing these different areas of educational research related to teacher learning: mathematics teacher education, educational psychology, and educational policy.

CHAPTER II: REVIEW OF THE LITERATURE

In this chapter I review the literature related to teacher learning and professional development in order to help me better understand the problems and gaps within the literature and guide my research. This review includes theoretical conceptions, specific research studies, and studies outside of the field of mathematics education, which provide additional perspectives to the research questions I investigate. All studies reviewed here are portrayed through the lenses of school contexts, policy, teacher professional learning experiences, and teacher communities of practice. However, it is important to note that for the purpose of this study and due to the difference in preservice and inservice teachers' learning experiences, I considered research studies related to in-service mathematics teachers' learning.

Moreover, throughout this proposal, I have used the terms *teacher learning* and *professional development* interchangeably. This is due to my beliefs and definition of professional development as an opportunity for teachers to learn. More specifically, I believe teacher learning is professional development, and may include (but is not limited to) collaboration, individual inquiry, experiences, workshops, conferences, or coursework, and can focus on such facet(s) of teaching as: content, pedagogy, classroom management, social factors, reform, or theory (Scribner, 1996). However, the research literature, depending on the field of research, includes different (in nature) recommendations, suggestions, and findings related to teacher learning and professional development. These fields of research include mathematics teacher education research, educational policy research, and educational psychology research related to teacher learning and motivation. It is for these reasons that I present my literature review in three

main sections: 1) mathematics teacher education research related to inservice teacher learning; 2) educational psychology research related to teacher learning and motivation; and 3) educational policy research related to teacher professional development.

<center>Mathematics Education Research Related to Teacher Learning</center>

I organized this section of the chapter by reviewing several aspects of the mathematics teacher education literature related to the research questions and theoretical conceptions of the framework of the study (Shulman & Shulman, 2004). Specifically, I framed the structure of this section in terms of the main components of the framework related to the study and research on effective models of teacher learning, which comprised of: a) research on teacher knowledge and understanding, b) research on teacher practice and teaching, c) research on teacher vision or beliefs about teaching and learning, d) effective models of mathematics professional development.

Teacher Knowledge and Understanding

The far-right vertex of the inner component of Shulman and Shulman's (2004) framework is titled "understanding." For this literature review, I adopt a wide usage of the term to include knowledge. As such, in this section, I review the literature on teacher knowledge and understanding.

One of the great complexities of teaching is being able to bring together multiple knowledge bases during the classroom instruction. However, these knowledge bases are not easily identified. Shulman (1987) argued that teachers must have a special kind of knowledge -- one that includes knowledge of learners and their characteristics,

knowledge of educational contexts, knowledge of educational ends, purposes and values, and their philosophical and historical bases - *the pedagogical content knowledge*. Fennema and Franke (1992) used Shulman's model to address *five* components in their model of teachers' knowledge: a) the knowledge of the content of mathematics, b) knowledge of pedagogy, c) knowledge of students' cognitions, d) context specific knowledge, and e) teachers' beliefs. The content knowledge of mathematics includes teachers' understanding of the concepts, procedures, and problem-solving processes within the domain of mathematics. Pedagogical knowledge reflects teaching procedures. Knowledge of learners' cognitions refers to how students think and learn.

Similar models have been developed describing teachers' PCK as a *five*-dimensional model including: a) subject matter knowledge; b) knowledge of students' epistemology; c) knowledge of curriculum; d) knowledge about assessment; and e) pedagogical knowledge that is specific to the domain in which teachers teach (Grossman, 1990). However, all these models commonly assume that pedagogical content knowledge (PCK) is the ability of the teacher to flexibly move between the subject matter knowledge, knowledge of and about learners, and knowledge of teaching, transforming content into forms that are "pedagogically powerful and yet adaptive to the variations in ability and background presented by the students" (Shulman, 1987, p. 15; Sherin, 2002). Thus, models of pedagogical content knowledge (PCK) collectively link together teachers' knowledge of *content, students, and pedagogy* (RAND Mathematics Study Panel, 2003).

Knowledge of content refers to the breadth and, more importantly, the depth of the mathematics knowledge possessed by the teacher; particularly, their *ways of*

understanding and *ways of thinking* (Harel & Lim, 2004). Teachers' mathematical knowledge and its conceptions have been evolving throughout the years. Not many years ago, teachers' subject-matter knowledge was defined in quantitative terms - by the number of courses taken in college or teachers' scores on superficial standardized tests (Ball, 1991; Begle, 1979; Wilson *et al.,* 1987). In recent years, teachers' subject matter knowledge has been analyzed and approached more qualitatively, emphasizing cognitive processes and understanding of facts (Hill, Shilling, & Ball, 2004), specific areas of mathematics (e.g., *Algebra Project YEAR;* Chinnappan & Lawson, 2005; Even, 1993), and concepts and principles and ways in which they are connected and organized in school curricula (see Mastorides & Zachariades, 2004; Stump, 1997; Even, 1990).

Hill, Schilling, and Ball (2004) argued teachers' mathematics knowledge for teaching in the elementary grades was partly *domain specific* rather than related to their teaching or mathematical ability. Hill, Rowan, and Ball (2005) defined mathematics knowledge for teaching (MKT) as, "mathematical knowledge used to carry out the work of teaching mathematics" (p. 373), which may include explaining terms and concepts, interpreting students' statements and solutions, judging and correcting textbook accounts of particular topics, and accurately using representations.

Knowledge of student learning refers to teachers' understanding of fundamental principles of child development and student learning (Harel & Lim, 2004). Whether the teaching and learning of mathematics should focus on conceptual understanding or procedural competency has been the hot topic of research debates for years (Ma, 1999, Hiebert, 1987). However, learning rote procedures in isolation has been found *not* to support conceptual understanding, and simply knowing the steps of a procedure does *not*

necessarily indicate conceptual understanding of a mathematical process (Silver, 1987).

Student learning has been found to be positively related to numerous factors and methods

of instruction; examples include: integration of visual arts (Hanson, 2002), learning

through mathematics journal writing (Koirala, 2002), providing real-world examples and

developing problem solving strategies (Moreno, Griffin, Denk, & Jones, 2001;

Shoenfeld, 1986), alternative and formative assessments (Black and William, 2004;

Ovedeji, 1994; Shepard, et al., 1996), and multiple representations (Ozgun-Koca, 2001).

However, after a substantial amount of research, it has been established that students

learn the best when students are provided opportunities to make connections between

concepts and processes, interpret mathematics from multiple perspectives, strengthen

their mathematical foundations, and possess an ability to reflect on previously learned

concepts. To do so we need knowledgeable, experienced, and educated teachers.

Ma (1999) compared conceptual understanding and procedural competency of

experienced U.S. and Chinese primary teachers across a range of mathematical topics.

She concluded that the major influence on students' learning of fundamental

mathematical ideas, on which all future learning and problem solving depends, was the

strength of their teachers' conceptual understanding of mathematics and their capacity to

use this understanding in classroom practice. Ma (1999) suggested that teachers should

incorporate meaningful examples, coherent explanations, and powerful processes of

mathematical problem solving in their pedagogy. Teacher knowledge of essential [to

student learning] pedagogical principles is critical for effective teaching.

Knowledge of pedagogy (PK) refers to teachers' understanding of how to teach.

This includes an understanding of how to assess both students' existing and potential

knowledge, how to utilize assessment to pose problems that stimulate students'

intellectual curiosity, how to promote desirable ways of understanding and ways of

thinking, and how to help students solidify the knowledge they have constructed (Harel &

Lim, 2004). Pedagogical knowledge about the nature of the discipline and the role of

teachers in regards to teaching and classroom practice has received more attention in

recent years (Ball, 1988, 1991; Even, 1990; Leinhardt and Smith, 1985; Shulman, 1986;

Tamir, 1987). Most early studies of teachers, as a result of curriculum development in the

1960's and 1970's, adopted a process-product research approach, where the role of a

teacher was viewed as managerial, and children's learning was assumed to be a direct

process of ready-made teacher-proof curriculum materials (see Brophy and Good, 1986;

Gage, 1978). However, the research on students' problem solving in the 1980's as well as

a marked change in conceptions of a teacher's role as facilitator rather than a manager of

learning resulted in other pedagogical practices that included setting mathematical goals,

creating intellectually stimulating classroom environments, and most of all, helping

students understand the subject matter by representing and communicating it in a

different way (Harel & Lim, 2004).

Teachers' PK has been expanded to attend to the rapid growth of computer

accessibility and technological advances around the world. The National Council of

Teachers of Mathematics (NCTM, 2000) states that "technology is essential in teaching

and learning mathematics; it influences the mathematics that is taught and enhances

learning" (p. 24). When technology is adopted in a school it becomes a significant force

in student learning. Today, more than fifty-five percent of fourth-graders and 44 percent

of eighth-graders have access to computers in mathematics classrooms. Seventy-four

percent of fourth-graders and 79 percent of eighth-graders had access to computers for mathematics in school computer labs or media centers. However, only 9 percent of fourth-grade teachers and 13 percent of eighth-grade teachers used computers to present mathematical concepts. Eleven percent of fourth-grade teachers and 32 percent of eighth-grade teachers used computers on a weekly basis to post homework, assignment, or schedule information on the Web. As a result, "In mathematics classes, technology was more likely used by students than by their teachers" (U.S. Department of Education, 2005, p.64).

Moreover, survey responses of mathematics teachers suggest that in 2004–05 almost half of America's students were in classrooms where teachers lacked access to district- or school-provided professional development on the use of computers for mathematics instruction (U.S. Department of Education, 2005, p. 14-15). This assertion is supported by research, which suggests that only about 20% of mathematics teachers feel prepared enough to integrate technology into classroom instruction (Archer, 1999; Lewis, et. al., 1999)).

At present, the requirement for teachers to know of and about available instructional technologies is greater than ever. Teachers are expected to be prepared to make decisions about various technologies, teaching mathematical skills with technology, and being able to address the pedagogical issues that arise from using technology as a teaching and learning tool (see Keating & Evans, 2001; Duran, 2000; Moursund & Bielefeldt, 1999). In other words, they are expected to have a Technology Pedagogical Content Knowledge (TPCK) (Keating & Evans, 2001; Niess, 2005; Pierson, 1999; Woodbridge, 2004).

Hence, to be able to teach students "one cup" of mathematical knowledge, teachers must have a full "bucket" of knowledge bases, including the knowledge of mathematics as a discipline, how teach it in a classroom setting of diverse learners, and where to find instructional tools that work the best for mathematical exploration and learning of specific topics. The research findings have demonstrated that the complexity and multidimensionality of teacher knowledge is immeasurable. Due to such immeasurability, it makes it extremely difficult for teacher educators to design teacher learning opportunities that not only encourage teacher engagement but also target to achieve their professional development and growth in knowledge bases needed to be effective teachers.

Moreover, when designing professional development it is unrealistic to separate what teachers know from what they do not know, or what they do during classroom teaching. Teachers do not teach mathematics in the same way every class period. Their instruction varies, depending on the context, students' attitudes and prior knowledge, and pre-established classroom norms and culture. In fact, even in two different classrooms where the same curriculum is in use, learning contexts look very different, in regards to the types of activities that are in use, "different learning opportunities available, different mathematical ideas under consideration, and different outcomes achieved" (Kilpatrick, 2003, p.273). This adds another variable to the complexity of designing professional development related to teachers' knowledge - teacher classroom practice. Classroom practice is vital to consider when examining teacher learning because it influences teacher knowledge, and, most importantly, it influences student achievement (Ball &

Cohen, 1990). Thus, in the following section, I examine research on teacher classroom practices.

Teacher Classroom Practices

Researching classroom practices is tremendously difficult. Besides the administrative intricacies of getting into the classrooms, researchers need multiple measures, a variety of procedures, and numerous trials. Yet, for decades teachers and teaching have been scrutinized, analyzed, commended, and criticized. The National Commission on Mathematics and Science Teaching for the 21st Century (2000) emphasized that the quality of classroom instruction is key to the quality of students' learning. Brown and Borko (1992) viewed instruction as "the process of facilitating students' comprehension," which "consists of a variety of teaching acts, such as organizing and managing the classroom, presenting clear explanations, and providing for student practice" (p. 212).

Research studies continually report that student achievement depends largely on teacher instructional practices, including learning mathematics with multiple solutions, perspectives, or representations (e.g., Schoenfeld, 1992; Stigler, Gallimore, & Hiebert, 2000), using worked-out examples and engaging students in problem solving (e.g., Sweller & Cooper, 1985; Renkl, 2005), having smooth transitions in the lesson or between activities or beginning a new topic by solving an example (Ma & Papanastasiou, 2006), attending to aspects of pupils' learning, and, in particular, recognizing their misconceptions and modifying or developing appropriate activities for students (Even & Tirosh, 1995), as well as planning mathematics lessons effectively (Little, 2001; Little 2003).

Generally, mathematics instruction has been categorized into *five* types: a) direct

instruction, b) individualized instruction; c) continuous progress; d) cognitively guided

instruction; and e) inquiry-based instruction. *Direct instruction* "is a highly structured

form of teacher behaviors that are thought to support student engagement in and learning

of mathematics" (Secada, 1992, p. 649). The format of such instruction includes carefully

sequenced teacher behaviors that guide students to learn mathematics in a structural

manner (Secada, 1992; Everston, Anderson, Anderson, & Brophy, 1980). *Continuous*

progress is a type of direct instruction; however, "students are to progress through a well-

specified hierarchy of skills, and they are grouped on the basis of their ongoing progress

through the curriculum" (Secada, 1992, pp. 648-649). The format of continuous progress

instruction connects teacher behaviors to student outcomes (mathematical knowledge and

skills) as a way to ensure students' progress in the learning of mathematics.

Individualized instruction acknowledges students' individual differences in their need

and ability to learn mathematics. At the center of individualized instruction is the belief

that each student learns mathematics in his or her own unique way. Consequently,

individualized instruction emphasizes various instructional strategies to facilitate the

learning of mathematics for *all* students (Ma & Papanastasiou, 2006). *Cognitively guided*

instruction (CGI), unlike direct instruction, does not regulate instructional behaviors of

teachers; instead, it allows mathematics teachers to be flexible in engaging students in the

process of learning mathematics on the basis of their knowledge bases and cognition

levels (e.g., Paas, Renkl, & Sweller, 2003; Sweller, Van Merrienboer, & Paas, 1998).

Inquiry-based instruction (also "constructivist" or "social-constructivist") ensures

opportunities for students to communicate mathematical ideas, solve problems

(individually or in groups), and engage in mathematical inquiry. The role of a teacher in such instruction is to value and reward students' effort and persistence, give pupils discretion on how they approach mathematical problems, and encourage them to use multiple representations during problem solving. *Inquiry-based instruction* represents fundamental changes in teaching practices - a shift away from the exclusive use of more traditional textbook-based lecture, in which the teacher is in complete control and the students' only goal is to learn operations to get the right answer (see, for example, Prawat, 1992).

One of the biggest influences on the shift in teacher practices has been The Trends in International Mathematics and Science Studies (TIMSS) and the recommendations of the National Council of Teachers of Mathematics (NCTM) *Standards*-documents. NCTM (2000) recommended that classroom practices be used that engage students in activities that require reasoning and creativity, assist them in constructing mathematical knowledge, help them gather and apply information, discover, and communicate ideas. Similarly, Hiebert et al. (2003), in the TIMSS 1999 video study, reported that although all countries were similar in the way they structured mathematics lessons (whole-class instruction or discussion is present in most mathematics lessons across all countries, with occasional attention to individualized student work), mathematics teachers in high-achieving countries (i.e., Australia, Czech Republic, Hong Kong, Japan, the Netherlands, and Switzerland) demonstrated *two* unique ways of teaching mathematics. *First*, in addition to devoting most of the classroom time to problem solving, teachers of these countries presented many more problems in mathematical symbols rather than real-life contexts. *Second*, mathematics teachers in high-achieving countries spend more time

working on new content than reviewing old content, paying close attention to the conceptual development of students' mathematical knowledge.

However, regardless of recommendations, many studies continue to report contradictory findings related to inquiry-based teaching practices, especially with regard to specific student populations (see Fantuzzo, King, and Heller, 1992; Verschaffel & DeCorte, 1997; Kroesbergen, Van Luit, & Maas, 2004). For example, Ginsburg-Block & Fantuzzo (1998) reported that peer tutoring, collaboration, and problem solving, together with contextualized instruction using real-world examples, increased mathematics test scores and levels of motivation for low-achieving elementary students. On the other hand, a study of 265 low-achieving elementary students found that students who received constructivist instruction did not improve significantly on mathematics performance (automaticity, problem-solving, strategy use, and motivation) in comparison to the control group that followed the regular curriculum. These researchers concluded, "Recent reforms in mathematics instruction requiring students to construct their own knowledge may not be effective for low-achieving students (Kroesbergen, Van Luit, & Maas, 2004, p. 233). Likewise, a US Department of Education Report (2006) on teacher quality and its relationship to student achievement also concluded that instruction focused around traditional practices, computation, measurement and advanced topics was positively associated with mathematics achievement gains for primary grades when compared to constructivist approaches to teaching.

In a review of literature, Reynolds & Muijs (1999) reported *six* central aspects of "effective" mathematics instruction. The *first* aspect that consistently and most strongly was found to predict student achievement gains was providing *high opportunities for*

students to learn (Brophy & Good, 1986; Hafner, 1993; Herman & Klein, 1996).

Opportunity to learn is not only related to factors like the length of the school day or the

amount of hours that students received mathematics instruction, but, more importantly, it

is related to the quality of classroom management, the quality of the activities students

engaged in, and the amount of time students were actively engaged in learning (Reynolds

& Muijs, 1999).

The *second* aspect, also a strong predictor of increased student achievement, is an

academic orientation of the teacher. Instead of focusing on social matters, group

dynamics, or students' socializing, effective math teachers placed huge importance on

classroom instruction. The goal of their instruction was to incorporate, as much as

possible, the curriculum-based activities and a business-like supportive learning

environment (e.g., Lampert, 1988; Cooney, 1994).

Third, effective teachers were able to *organize and manage* their classrooms

effectively by integrating smooth transitions between lessons or activities, beginning with

a brief introduction and closing a lesson with a summary of the learned material,

spending little time dealing with inattention (Brophy & Good, 1986). During their

lessons, the teachers regularly altered their teaching strategies, used positive rather than

negative language, and acknowledged and reinforced desired behavior from students

(Reynolds & Muijs, 1999).

Fourth, effective teachers typically hold *high expectations for their students*,

emphasizing the importance of effort and its relationship to outcomes, and continually

reminding students about the importance of their work (see Borich, 1999). *Whole class

instruction*, rather than letting students work individually, was found to increase student

achievement outcomes as well. However, it did not mean that effective mathematics teachers stood in front of the class and lectured. On the contrary, effective teachers spend more time on whole-class discussion of problems, thoughtful and thorough explanations and solutions, enhancing contact and time-on-task by spending less time on classroom management (Good, et al., 1983; Mason & Good, 1993; Borich, 1996). Teachers who provide more whole-class instruction also spent more time monitoring students' achievement. They usually organized the teaching as a personal presentation of the information to the class without relying much on a textbook or curriculum materials, followed by recitation and opportunities or activities that focused on application of the newly learned material. Such instruction has been referred to as "direct" instruction (Lampert, 1988; Brophy & Good, 1986; Borich, 1996). Moreover, effective teachers were found to be *heavily interactive*; they ensured a great deal of student communication by asking more open-ended and process questions, involving them in discussions, eliciting group explorations, allowing more wait time, and providing substantive feedback (Reynolds & Muijs, 1999).

Hiebert and Grouws (2007) argued that teachers must attend to *two* fundamental aspects of classroom mathematics teaching to facilitate students' conceptual understanding and achieve *mathematical proficiency* (NRC, 2001): a) explicit connections among ideas, facts, and procedures, and b) engaging students in struggling with important mathematics. These two features, though general, "operate effectively across a range of contexts and teaching systems" (p. 391). *Mathematical proficiency* is defined as five kinds of mathematical competencies (conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition)

that are intertwined and are interconnected and must be embedded into the classroom practices because "instruction should not be based on extreme positions that students learn, on one hand, solely by internalizing what a teacher or book says or, on the other hand, solely by inventing mathematics on their own" (*Adding It Up,* NRC, 2001, p.12).

All of the above suggestions related to teacher classroom practices have been at the center of teacher professional development programs in the past decade. It is clear that teachers must know about these "effective" instructional strategies and, most of all, must be able to use them in their classrooms. However, little research is available on how teachers come to learn about these strategies and the types of learning that makes teachers successful using these instructional practices in their classrooms. Limited research findings are available on the strategies teachers actually choose and try out in their own classrooms, or, most importantly, what makes them believe in these unfamiliar strategies and that they buy-in to them and work hard to implement them in their classrooms to increase student achievement and learning.

Research is emerging on the claims that professional development programs designed to help teachers implement inquiry-based mathematics instruction are minimally effective, in part because teachers filter what they learn through their existing *beliefs* (see Schram & Wilcox, 1988; Skemp, 1978). Cohen and Ball (1990), for example, observed in their study that teachers assimilated new practices to their more traditional beliefs about mathematics education. They described it as, "New wine was poured, but only into old bottles" (p. 334). A substantial body of research suggests that teacher beliefs and attitudes about teaching and learning directly affected their teaching practices (e.g., Clark & Peterson, 1986; Fang, 1996; Kagan, 1992; Thompson, 1992). Thus, teacher

beliefs cannot be overlooked when discussing teacher learning and designing effective professional development.

Teacher vision and beliefs

The French author Anatole France once said, "To accomplish great things, we must not only act, but also dream; not only plan, but also believe" (Herbert, 2001, p. 43) Teachers' classroom accomplishments, their acts of teaching, their dreams about students' learning, and their lesson planning are all largely influenced by their philosophical beliefs about pedagogy and epistemology. Teachers' own philosophical beliefs serve as a filter, influencing decisions and actions before, during, and after the act of teaching (Philippou & Christou, 1997; Schram & Wilcox, 1988; Skemp, 1978; Ball & Cohen, 1990). These beliefs develop into a coherent philosophical system that directly influences the classroom organization, mathematical activities, questions teachers ask during instruction, and homework assignments. In other words, what teachers do in their classrooms is ultimately a product of their beliefs (Cooney, 2001).

However, the nature of how beliefs are connected to classroom practice has been the subject of controversy (Beswick, 2005), especially relation to how one aspect impacts the other. For example, Guskey (1986, cited in Cobb et al., 1990) argued that changed practice leads to changed beliefs. On the other hand, Cobb et al. (1990) suggested that rather than linearly relating the two in a causal way, beliefs and practice should be thought of as influential and developmental of one another. Beswick (2003) examined a number of studies that reported similar inconsistencies. She claimed that the sources of such inconsistencies are the differences in the research contexts, either in which teachers provided data concerning their beliefs, or the contexts in which their practices were

observed and described. Beswick (2003) argued that these mismatches accounted for the apparent conflicts and the only way to resolve them is to better understand the *contextual nature* of teacher beliefs (Hoyles, 1992).

Teacher beliefs are also connected to teacher behaviors. For example, Green (1971) proposed a three-dimensional model as a metaphor for visualizing a belief system. The *first* dimension, referred to as ''psychological strength'' (p. 47), describes the relative importance a person places on a certain belief. Both Rokeach (1968) and Green (1971) describe this dimension as varying from central to peripheral, assuming "the more central a belief, the more it will resist change" (Rokeach, 1968, p. 3). Rokeach (1968) also introduced the idea of connectedness as a means of exploring the central or peripheral nature of a belief. Beliefs can vary with respect to the degree to which they exist, are shared, and are derived. *Existential* beliefs are those we associate with our identity – with who we are and how we fit into our world. They have a high degree of connectedness and are strongly held. However, if a belief is derived from an association with a group, then it may be less connected and thus more peripheral in nature.

A *second* dimension is the individual's organization of his or her own beliefs in quasi-logical relationships (Green, 1971). For example, many teachers believe there is a logical relationship between students learning times tables and their use of calculators. Consequently, the author argues that teachers possess strong beliefs that are *derivative* (use of calculators), which are dependent on their *primary* beliefs (memorizing times tables).

A *third* dimension of belief structure is the extent to which beliefs are clustered in isolation from other beliefs (Green, 1971). Beliefs seen as contradictory to an observer

may not be seen as contradictory to the holder of those beliefs. Contradictory beliefs may exist in different belief clusters with no explicit reference to context, and although not all beliefs are evidential (based on evidence), the ones that are, could be based on what was perceived as evidence by the holder of the belief.

Recently, much has been also said about the distinction between knowledge and beliefs (Furinghetti & Pehkonen, 2002; Thompson, 1992). Of all the things we believe, there are some things that we "just believe" and other things that we "more than believe – we know." (Leatham,2006, p. 92). Ernest (1991) suggested that mathematics teaching depends on the teacher's belief system and especially on his or her conceptions of the nature and meaning of mathematics. These beliefs affect teachers' perceptions of how mathematics should be presented, "The issue is not, what the best way to teach mathematics is, but what mathematics is really about" (Hersh, 1998, p. 13). Teacher philosophical beliefs first were defined as, "teachers' conscious and subconscious beliefs, concepts, meanings, rules, mental images, and preferences concerning the discipline of mathematics" (Thompson, 1992, p. 132). Ajzen and Fischbein (1980) referred to beliefs as anything that an individual regards as true.

Philipp (2007) explained and clarified the difference between several terms that have been associated and used interchangeably related to teacher beliefs. In his definitions, *beliefs* are "psychologically held understandings, premises, or propositions about the world that are thought to be true" (p. 259). In comparison to attitudes, beliefs are harder to change because they are less intense and more cognitive in nature. *Belief systems* were defined similarly as Green (1971), in which they are thought of as metaphors to describe the ways in which person's beliefs are always organized in clusters

around a specific concept or idea. Beliefs systems can be primary or derivative, or central

or peripheral, but never held in isolation (might be thought of as existing clusters).

Knowledge was described as "beliefs held with certainty or justified true belief" (Phillips,

2007, p. 259). Once a belief is no longer in question, it becomes knowledge, thus what

might be knowledge for one person may only be a belief for another. Several other

aspects related to beliefs were discussed in this chapter, such as: *teacher affect*, which

consists of teacher attitudes and emotions, and *beliefs* that teachers hold in regard to what

is desirable/undesirable – teacher values. However, Philipp (2007) concluded:

> I know of no research linking teachers' affect about mathematics and
> mathematical learning to their classroom instructional decisions, but the prospect
> that the two may be linked is sufficient reason to think more carefully about what
> can be done to support prospective and practicing teachers in developing more
> positive affect towards mathematics and mathematics teaching and learning….In
> service work with practicing teachers generally does not include evaluative
> components, and some in-service providers attribute their success to the non-
> evaluative aspect of experience (p. 302-303).

The literatures on teacher knowledge, practice, and vision are broad and, in some cases,

quite deep. Less is known about the last vertex of Shulman and Shulman's (2004)

framework – motivation. As a result, the purpose of the next section was to review any

available literature on teacher motivation or willingness to learn, and to provide evidence

that little research is currently on teacher affect and motivation to learn, and possible

factors affecting teacher professional learning.

Effective Models of Mathematics Professional Development

      The literature review is organized in this subsection mirroring the suggestions of

Guskey and Sparks (1996) related to the nature and structure of professional

development: 1) the content of effective professional development (what is to be

learned); 2) the processes of effective professional development (how the content is to be learned); and 3) the contexts of effective professional development (environment or conditions under which the content is learned).

The content of effective professional development. Research on teacher learning has been widely focused on helping teachers understand (a) subject matter, (b) learners and learning, and (c) teaching methods. In the past two decades, research studies continually indicated that focusing professional development on these content goals offers teachers what they need to be able to teach mathematics well (see Hill, Shilling, and Ball 2004; Shulman, 1986; Kennedy (1998).

Hill, Shilling, and Ball (2004) provided evidence of effective professional development, which specifically focused on increasing teachers' mathematical content knowledge, had positive correlation to student mathematics achievement. The authors suggested that teachers must know the mathematics they are teaching; however teachers' mathematics knowledge is complex in a way that it attends to the conceptual nature of mathematics, pedagogical underpinnings of teaching mathematics, and student development, understandings, and learning of mathematics.

Similarly, according to Shulman (1986), pedagogical content knowledge is the province of experienced teachers; new teachers and teachers new to a subject or grade level need to acquire it through study and reflection on their teaching practice. This connects directly to the teacher learning research, which emphasized teachers' understanding of the concepts related to teaching and learning mathematics, and knowing how to apply that knowledge to new and challenging situations.

In her review of in-service programs that provided evidence of improved student

learning, Kennedy (1998) suggested that programs that focus on helping teachers learn how students learn the subject matter are most successful in improving student achievement. Kennedy explained that, by learning about how students learn the subject matter, teachers also learned the subject matter themselves and learned how to teach the subject matter and how to recognize students learning of the subject matter.

In summary, the research suggests that effective professional development must attend to mathematics teachers' subject matter knowledge, especially related to students' understanding and learning of the content and the pedagogical underpinnings related to the teaching of that particular content.

Processes of effective professional development. The NRC (1999) report described four different environments that promote human learning. Susan Loucks-Horsely (1999) adapted these environments to reflect effective teacher learning and described them as: learner-centered, knowledge-centered, assessment-centered, and community-centered. *Learner-centered* learning environment becomes effective if it acknowledges and incorporates the activities that built on what teachers know and are able to do, and if it bridges these activities and teachers' knowledge to new understandings (Duckworth, 1987). *Knowledge-centered* learning environment is focused on the need to make teachers more knowledgeable by learning in ways that lead to understanding and knowledge transfer (Bruner, 1981). *Assessment-centered* teacher environment have been identified as effective if it provided opportunities for feedback and revision. These types of learning environments include opportunities and time for teachers to reflect and become more reflective, not only on what they are teaching but also reflect on what they are learning and how they can apply what they learn into their

classrooms. *Community-centered* effective learning environment create opportunities and time for teachers to work together, reflect together, and provide feedback for each other. At the heart of community-centered environment is "people learning from one another and continually attempting to improve" (Loucks-Horsely, 1999, p. 260). These four characteristics of effective learning environments provided a foundation for developing specific kinds of learning experiences that teachers need to be able to implement challenging reforms both at the classroom level and at the school and district levels.

Loucks-Horsley, Stiles, and Hewson (1996) in their synthesis of standards for professional development strongly suggested that effective teacher learning experiences must be based on sound principles of learning and based on successful teaching models that ensure student learning. These principles include active engagement, learning over time, and ways to apply what is learned to the teacher's own classrooms (Loucks-Horsley, Stiles, & Hewson, 1996).

Moreover, surveys of professional development indicated large discrepancies between what is known to be effective and what teachers experience as professional development (Loucks-Horsley, Hewson, Love, & Stiles, 1998; NCTAF, 1996). The results showed that professional development often occurred in one-time sessions, during which teachers did not have the opportunity to study deeply the new ways of learning and teaching mathematics. Their learning was not focused on mathematics or connecting mathematics to their own teaching, nor did they have opportunities to build a community of learners with their colleagues by studying closely together. Furthermore, professional development was disconnected from other initiatives in the school or district – "ones that touch the very same teachers but are experienced by the teachers as having different

goals, activities, and organizational arrangements" (Loucks-Horsley, Stiles, & Hewson, 1996, p. 37). Therefore, the authors strongly suggested that research on effective professional development models is critically needed, especially to be able to depart from such fruitless and unsuccessful scenarios.

Darling-Hammond and Ball (1998) provided an overall outline for several effective models for teacher learning. The authors suggested developing professional discourse around problems of practice and content-based professional development. Darling-Hammond and Ball claimed that traditional forms of professional development provide answers to questions, convey information, teach skills, and provide curriculum materials with instructions on how to use them. However, a more effective professional development needs to be based on the principles of active learning, shortcutting the distance between the new knowledge and applications of that knowledge to the classroom. Such learning uses artifacts of practice (e.g., student work, teacher journals, classroom videos, or narrative cases) and allows teachers to examine and analyze those artifacts deeply discussing important issues of learning and teaching. The authors also suggested that content-based professional development is critical because it provides teachers with opportunities to develop mathematical understanding useful for their teaching, which is often neither the focus nor the goal of typical university science or mathematics courses.

In their attention to design of professional development programs and initiatives, Loucks-Horsley et al. (1998) identified different strategies and models of effective professional development that contribute to teacher learning and can be categorized into five overarching processes: immersion, curriculum, examining practice, collaboration,

and vehicles and mechanisms. *Immersion* strategies involve participants "doing" mathematics and solving mathematical problems. These types of processes include teachers working in their content field for extended periods of time, perhaps spending a summer with a research team or industrial setting, working on mathematical problems and conducting scientific inquiries to experience authentic learning. *Curriculum* strategies include teachers actually experiencing learning and curricular materials they will be using with their students. Curriculum adoption, implementation, and development is typically at the core of these processes and teachers are involved by teaching a unit or a topic that is new to them (or in taught in a new way), which essentially builds on teachers' mathematics knowledge, teaching skills, and beliefs about teaching and learning. *Examining practice* typically involves teachers' own practice and "job-embedded" learning. This type of learning involves teachers' examination of artifacts of practice. Such models of professional development as study groups, video or narrative cases of teaching dilemmas, lesson study, and action research are prevalent to these processes. *Collaboration* strategies of effective professional development have become quite common, and generally include teacher professional networks inside and outside of school boundaries, collaboration with scientists, mathematicians, and educators, and working with coaches and mentors. *Vehicles and mechanisms* involve developing and creating successful strategies and structures through which learning can be achieved. Loucks-Horsley et al. (1998) indicated that workshops and institutes have been known to be the most common structures through which teachers have been learning; however, if designed well, those can be powerful and produce significant outcomes. The authors explained that at the core of this process is developing professional developers, who will

be ready to prepare teachers and other educators to provide professional learning opportunities to others.

Contexts of effective professional development. Research on the influence of context on teacher and student learning has come from a variety of perspectives and claims. However, many research studies regarding the importance of professional development contexts have not focused on mathematics teachers, but on teacher learning in general. Little (1982) found that norms of collegiality, collaboration, and experimentation characterized schools in which teachers learned continuously. Rosenholtz (1991) also explained that there are schools that are "learning-enriched", meaning that teachers worked closely together and supported each other around issues of teaching and learning, in comparison to "learning-impoverished" schools. The QUASAR project, which examined the implementation of the reform-oriented mathematics programs in urban middle schools, described one school in which a strong professional community of practice nurtured teacher learning and collaboration and was particularly effective in new teacher induction programs (Stein, Silver, & Smith, 1998). All of these authors also found increased student achievement to accompany these collaborative school cultures (see Little, 1982; Rosenholtz, 1991; Stein, Silver, & Smith, 1998).

On the other hand, Fullan and Hargreaves (1996) and McLaughlin (1993) have documented specific cases of schools where collaborative environments stifled the school reform, devastated teaching innovation, and reinforced traditional practice. Thus, it is not the collaboration of teachers that is central to the teacher change, but rather the focus of the collaboration that is important and perhaps leads to learning gains. For example, in schools recognized by the U.S. Department of Education for incorporating teacher

support and effective models of professional development, professional development decisions are directly aligned with student learning goals and the focus of professional development is largely to analyze student achievement data and determine goals for teacher improvement, and increase in knowledge and skill (Killion, 1998). The Success for All Program is another program that identified specific professional development features that improved student achievement. Success for All Program combines intensive mathematics (and reading) curriculum with constant diagnosis of learning problems, immediate intervention (including direct tutoring to target the problems), cooperative learning, and family support teams. The staff development program is spread throughout the year, with heavy emphasis on follow-up implementation (Joyce et al., 1993). Through professional development, teachers and family support teams learn to combine curriculum, instruction, and tutoring to meet students' learning needs.

Research on successful schools with high student achievement also emphasized the need for strong leadership amongst the teachers and leadership for professional development. In their study of low and high performing schools, Harkreader & Weathersby (1998) found that higher performing schools had principals, district staff, and other decision makers who were advocates for professional development focusing on student achievement, school goals, and staff's needs. These leaders sought resources for teacher development and motivated the majority of staff to participate (Harkreader & Weathersby [Georgia Council for School Performance], 1998).

Research suggests that educational systems and structures need to be aligned with the content and goals of teacher learning. For example, many studies suggested that when assessments, certification requirements, and reward systems are aligned and supportive of

teacher change (both in their knowledge and behavior), teacher learning takes on new

meaning and value and is organized around a common set of goals and challenges (Cohen

& Hill, 1998; Corcoran, Shields, & Zucker, 1998). Stanford Research International (SRI)

reported that high quality professional development opportunities, even those that

produced student gains in mathematics and science, were severely limited by state and

district policies, costs, and scale issues. The study found that Statewide Systemic

Initiatives (SSI) were hindered by lack of alignment of state policies for professional

development, especially because the goals of the district and state policies were

mismatched between small scale local changes and large scale state-wide reforms

(Corcoran et al., 1998).

Cohen and Hill (1998) studied California state policy, teacher learning, and

student achievement - specifically the influence of assessment, curriculum, and

professional development on student achievement as a function of implementing state

mathematics reform. Their results suggest a model in which teacher knowledge, teaching,

and assessment practices are effective but only if policy provides opportunities for

teacher learning - in particular, professional development focused on the teachers' own

curriculum and classroom as a channel to improving student performance.

I end this section with a quote by James Hiebert. In his review of the research on

mathematics teaching and learning, Hiebert called attention to the importance of high

standards, content focus, and in-depth learning opportunities for teachers:

> Research on teacher learning shows that fruitful opportunities t**o** learn new
> teaching methods share several core features: (a) ongoing (measured in years)
> collaboration of teachers for purposes of planning with (b) the explicit goal of
> improving students' achievement of clear learning goals, (c) anchored by attention
> to students thinking, the curriculum, and pedagogy, with (d) access to alternative

ideas and methods and opportunities to observe these in action and to reflect on the reasons for their effectiveness (1999. p. 15)

Educational Psychology Research Related to Teacher Learning

Due to the vast majority of educational psychology literature focusing on student achievement outcomes and student motivation to learn, this section of the chapter includes a review of the educational psychology literature related to teacher development in general. Therefore, the sections within this part of the chapter have been organized as the following: 1) teacher motivation to learn; 2) teacher efficacy theory; 3) and teacher efficacy in relationship to teacher learning.

Teacher Motivation to Learn

Two types of research studies were evaluated and reviewed: a) descriptive studies, which described teacher learning processes through different lenses, one of which was motivation or affect, and b) prescriptive studies, which mainly tended to report the results of an intervention and provide general recommendations on what or how to motivate teachers to learn. Consequently, the *descriptive* studies tended to predominantly use either a mixed-method or qualitative research design methodology, whereas *prescriptive* studies were more inclined to be quantitative in nature. I begin my review with descriptive studies and gradually move to the prescriptive studies. Historically, teacher motivation for professional learning and performance was defined, measured, manipulated, and explained through "*rewards.*" Since the 1800's, most of the policy documents described the reward systems as part of the education "policy tools" for teacher motivation. These tools were not only influenced by, but were reflective of

political, economic, and social conditions of the country (Prostik, 1995; Kelly & Odden, 1995).

Research on what motivates teachers to teach (which is different from what motivates teachers to learn) and types of incentives that motivate teachers to perform at their best has been conducted since the beginning of the 1900's (e.g., Lotus Delta Coffman, 1911; Elsbree, 1939; Carlson, 1961; Brandt, 1990). The National Educational Association (NEA) surveyed teachers every five to seven years related to teachers' career satisfaction (e.g., salary, colleagues, educational system), fulfillment from classroom teaching and working with students, and opportunities for personal growth and growth within a society (NEA, 1967; 1972; 1977; 1982; 1992). Even though earlier reports described teacher motivation in terms of economic (e.g., financial) and honorific rewards (e.g., respect from the community), later studies have found that teachers tend to value their work with students more and more. In fact, 76% of teachers in 1964 and 70% in 1984 reported that the most important feature of their career was to be able to "study, plan, master classroom management, 'reach' students, and associate with colleagues and children" (Lortie, 1975, p. 105; Cohn & Kottkamp, 1993, p. 61).

Current research findings indicate that the present "reward system" is not effective in promoting teacher improvement on teaching and learning. For example, Adelman and Kenyon (1996) provided evidence of the challenges they faced with the distribution of rewards for the Kentucky Instructional Results Information System (KIRIS) Project. The study identified six major challenges connected to motivation of teachers for learning and improvement: a) involving teachers in the actual design process of the incentive program, especially making sure to provide both the autonomy and

include teachers in conversations and decision whether such system for allocation is what teachers want; b) linking rewards to individual student performance in a sense that by focusing on students, and not cohort teachers, can discredit the design by pointing to changes in student population from year to year; c) resolving issues of fairness, especially in cases when teachers are being rewarded or punished without fully understanding why they are being treated one way or another; d) defining a process and usage for rewards funds -- in this case the teachers were given a full authority to decide how to allocate the reward funds; e) clear link between the distribution of rewards and continued teacher improvement of teaching and learning; and f) ensuring state rationale for incentive program. The majority of recent studies on teacher motivation through incentives and rewards have concluded that there is a tendency among teachers to overlook the importance of economic rewards and to overemphasize the importance of intrinsic ones (Ozcan, 1996). "Despite a century long history of the incentive programs, discovering what matters to teachers and how best to motivate them is still a complicated puzzle" (Ozcan, 1996, p. 4; also see Johnson, 1990; Rhodes & Ogawa, 1992; Cohn & Kottkamp, 1993).

Empirical research in the field of psychology has also provided strong and well-built evidence that we all are different in our intentions, abilities, interests, and motivation to learn, and teachers are no different. In fact, teacher *intentions for learning* vary between extremes. On one hand, teachers participate in implicit learning without having any intentions or awareness of the learning. On the other hand, teachers learn as a result of reacting to something that happened unplanned or spontaneously. Also

numerous teachers participate in learning deliberately, exerting great efforts and setting aside the time (Eraut, 2000).

Teachers also vary in their cognitive, affective, and meta-cognitive *abilities to learn*. It is not unusual for teachers to vary in the way they reflect upon situations, transfer their knowledge, choose learning routes, and use learning resources (see Onstenk, 1997; also Bandura, 1997; Vermunt, 1996; Zimmerman, 2000). However, a recent study reports that teacher willingness to learn does not involve intentional, goal-directed, self-regulated aspects of learning, because *willingness to learn* is simply teachers' "desire to learn, experiment, and see or do something has not been seen or done before" (Van Eekelen, et al, 2006, p. 411). The construct of willingness to learn assumes teacher learning as a workplace experience that results in teachers relearning things they once knew and achieving different types of learning outcomes (e.g., transactional, conservative, progressive, [see Hashweh, 2003]) by "establishing" or "more or less changing" their knowledge, skills, or attitudes with teachers being aware of the learning process.

Van Eekelen, et. al. (2006) found that teachers vary in their *willingness to learn*. Some are "eager to learn" constantly seeking learning opportunities and taking actions in order to learn. These teachers are well aware of their strengths and weaknesses and can easily recall explicit information (both content and process) about their learning experiences. On the other hand, there are teachers who are "ready to learn" but do not know how. These teachers may be as explicit about some of their learning experiences as teachers who are eager to learn, but they do not make learning resolutions let alone take actions to implement them. They may also not be close to others (e.g., colleagues) and

not as "flexible with regard to the guidance of the learning process" (Van Eekelen, et al, 2006, p. 416). And last, some teachers simply "do not see the need to learn". These teachers are easier to distinguish from the other two categories because they hold on to established habits of teaching, they are not open-minded to suggestions or to others, often find it hard to describe their professional learning experiences, and attribute disappointments to external factors (e.g., school context, educational system, students) (Van Eekelen, et al, 2006).

These findings are consistent with other research results. Teachers' personal characteristics were found to impact their receptiveness to teacher development, yet social trust and *teacher efficacy* as personal characteristics related to teacher learning outcomes were found to evolve from professional development efforts (see Fisler & Firestone, 2006). In fact, research has identified teacher efficacy as the most important component of the teacher belief system in terms of its effect on student achievement and what kinds of teaching and learning is going on in the classroom (e.g., Agne, 1992; Ashton & Webb, 1986; Guskey, 1988; Scribner, 1996). For example, teachers with a high sense of efficacy were found to hold a firm belief that they can teach *all* children, including the difficult and unmotivated (Berman et al., 1977).

However, due to its complexity and internal nature, no best or accurate ways exist to measure or capture the nature of teacher efficacy beliefs, or to identify how to strengthen or develop teacher efficacy (Woolfolk & Hoy, 1990). Thus, many inconsistencies exist within teacher efficacy research findings. Some researchers argue that educational reforms, especially related to new and innovative philosophies of teaching and learning, are difficult for teachers, particularly during their initial five years

of implementation. Researchers reported that teachers felt quite uncomfortable with their reform awareness and their abilities to use innovative practices (van den Berg & Ross, 1999). Teachers were found to continually resist educational changes, and express disappointment with not being able to manage the reform changes competently and losing the autonomy of their classrooms (Amit & Fried, 2002). Researchers also argued that mathematics teachers who demonstrated higher efficacy for using the tested and trusted teaching methods were found to be more critical of the reformed educational movements and implementations than their less efficacious counterparts (Fullan, 1999).

On the contrary, it has been argued that higher efficacy is associated with the use of more challenging teaching techniques, and most of all with teachers' willingness to try innovative instructional methods (e.g., Ghaith & Yaghi, 1997; Guskey, 1988; Rangel, 1997). It has been claimed that highly efficacious teachers are active in collaboration and often teach in schools characterized as low-stress places. These teachers usually carry a joint commitment to collective learning goals (Warren, 1993) and symbolize a forward-looking flexible culture in the school districts.

Several explanations can be provided to explain these inconsistencies. First, teacher efficacy is a construct that can only be captured by self-reported data, thus creating a methodological difficulty of measuring what one knows about his or her beliefs. Typically, teacher efficacy has been measured by teacher self-reports or scale surveys varying from one to 30 or more Likert-scale items, the questions of which usually addressed a range of teaching tasks and situations, and the scores from these questions were typically averaged across all the subscale items giving a single index of

teacher efficacy. Thus, two teachers whose classroom practices are dissimilar may have an overall subscale score of 4.

Second, teacher efficacy often had been confused with *teaching effectiveness*, which is problematic in possible errors that researchers could have made capturing teachers efficacy beliefs, underestimating, or overestimating, their actual teaching effectiveness. Consequently, teacher efficacy remains a conceptually elusive construct, difficult to capture with greater certainty (Hebert, Lee, & Williamson, 1998).

Smylie (1988) suggested three categories of interrelated factors influencing change in an individual teacher's practice as a result of staff development opportunities: (a) teachers' pre-training psychological state, (b) characteristics of teachers' task environment (classroom), and (c) dimension of school context. An alternative teacher learning model has been proposed to account for teacher learning processes in which the quality of learning is the direct result of their motivation for learning and how it affects their performance. For example, Usuki (2001) proposed a theory of teacher learning by Biggs & Telfer (1989), where teachers are metacognitive about their learning -- i.e., they become aware of their cognitive process and monitor their own progress through the learning activities. At the heart of this learning is *autonomy*. Autonomous learners get ideas for effective learning through learning experiences; they transfer knowledge by drawing connections inside and outside the learning experiences. Autonomous learners are self-analytical and are well aware of their learning capabilities, and they know what it takes for them to learn effectively without negatively affecting their future learning. When learning autonomously, learners are not provided with an environment but instead are seeking to make learning environments for themselves, thus such learning will not

necessarily require space or time freedom, but require internal freedom. Thus, teachers who are autonomous learners would be constantly seeking opportunities to learn, rather than waiting until these opportunities are offered or mandated to them (see Biggs & Telfer, 1989; Usuki, 2001).

Autonomy also was found to play an important role in high school teachers' willingness to learn about reform teaching strategies and willingness to implement the reform-based instructional unit on geometry, adapting more compatible [with the reform movement] teaching practices (Manouchehri, 2004). The two groups of autonomy-supportive and controlling style of motivation of high school teachers from an urban district were observed over the course of 5 months as they implemented a reform-based unit of instruction in geometry. Adoption or implementation of reform-based instruction were the main mediators for many studies for observing teacher motivation to learn about the reform views on teaching and learning and adopting these views into their classroom (Manouchehri, 2004).

Additionally, four teachers from the Singapore Catholic Elementary School were observed in their classrooms implementing cooperative learning strategies after receiving professional training on cooperative learning (Lee, Chew, Ng, & Hing, 1999). These researchers concluded that there are ideological impediments to teachers accepting cooperative learning and using them in their classrooms. These impediments are *teacher's beliefs* about the purposes of schooling and learning, even after reasonably well executed workshops (Rich, 1990; Lee, Chew, Ng, & Hing, 1999). In this study, all but one of the teachers "took the initiative to experiment with cooperative learning" even after receiving school-based professional training (p. 17). Only when teachers had little

choice but to adopt cooperative learning, as part of their school involvement in the project, did they began to gradually implement cooperative learning strategies during the school year (Rich, 1990; Lee, Chew, Ng, & Hing, 1999).

The *role of community* and leadership in teacher motivation to learn has also been studied. For example, Hord (1997) suggested that "effective school restructuring requires teacher motivation and action to transform knowledge about change into reality" (p. 1). By conducting a synthesis review of five case studies conducted by Louis and Kruse (1995), Hord (1997) identified several critical aspects that were important for teacher learning. First, in the study, teachers were part of a supportive professional community, with a shared vision of increased student learning, who studied, worked, planned, and took actions collectively. Moreover, the staff was part of the professional learning community, which reduced teacher isolation, increased their commitment to the mission and goals of the school, created shared responsibilities and powerful learning that defined good teaching and classroom practice, and helped enhance teachers' understanding of course content and teacher roles. In addition, teachers in this study felt higher satisfaction with their learning and development process, reported increased and positive morale and reduced absenteeism (Hord, 1997).

Teacher leadership has been one of the important issues widely discussed in research studies on teacher learning communities (Wenger, 2001; Stigler & Hiebert, 1999; Ingersoll, 1999). Stigler and Hiebert (1999) argued that one of the problems schools face is that there are few leaders among its teachers for initiating, starting, and leading the needed reform efforts. The shortage of teacher leaders is impacted by insufficient knowledge among our nation's teachers of mathematics (Ingersoll, 1999).

Koency and Swanson (2000) presented stories of three middle school teacher leaders, who shared their experiences as leaders in teacher community as well as the challenges they faced as leaders, as teachers, and as learners who are still emerging as teachers. One of the major findings of this study related to teacher learning and motivation was that to realize the reform efforts and promote teacher improvements, mathematics education professional development opportunities must be coupled with opportunities that target teachers' need to grow as professionals, developing teachers' commitment to raising levels of student mathematics achievement, and helping teachers in "making personal changes and improvements to positively affect their teaching quality" (Koency & Swanson, 2000, p. 1). Similarly, several studies suggested that teacher leadership serves as a great motivator for teacher learning and development (Wagner, 2001; Koency & Swanson, 2000; Eaton, 2005), and opportunities for teachers to grow professionally must carefully consider the following aspects of motivation: a) risk aversion, b) the "craft" expertise; c) autonomy and isolation, d) "buy-in" versus ownership; e) understanding the urgent need; f) teacher shared vision and beliefs; and g) teacher relationship based on mutual respect and trust (see Wagner, 2001; also Eaton, 2005).

The intersection between two motivation theories, known as *self-motivation* and *self-determination* theories, encapsulate many of the research constructs discussed above. These two theories view individuals as active by nature and driven to continually adapt to changes in the environment in order to be successful (Dzubay, 2001, p. 8). However, their energy cannot be assumed as infinite; thus if teachers are not learning, it means they are expending energy in other areas (perhaps on the demands placed on teachers' time

and energy by the administration, school, and policy contexts). *Self-motivation* and *self-determination* theories assume that motivation cannot be "done" to someone, it cannot be controlled or commanded into being; however, it can be studied, analyzed, described, and worked to inspire. Three important aspects are thought to make up learners' motivation: a) personality (self); b) satisfaction of psychological needs; and c) experience in social contexts.

Personality or self "is an integrated, psychological core from which a person acts authentically, with true volition" (Deci & Ryan, 1995, p. 5). Self must not be avoided and people should be allowed to be who they really are. This will stimulate greater responsibility and increase self-directed actions. Consequently, if a teacher attended a professional development on instructional strategies that did not interest her, she is unlikely to integrate those approaches into her own classroom. Research in psychology concluded that people posses *three* inherent *psychological needs* that must be satisfied: a) autonomy, a drive to retain a sense of freedom, independence, and sovereignty regarding our actions; b) competence, a desire to be good at whatever it is that we choose to do and what's valued by the community; c) relatedness, an impulse to have meaningful connections with others.

The last construct is teachers' *experience in social contexts.* We all operate in a community that can either support or impair our development. Similarly, teachers' experiences within a group or with certain individuals in the school community will largely determine the extent to which they adapt to challenges within their environment. In fact, people who hold significant roles in our lives (e.g., parents, spouses, family members, or friends) have a great influence on our motivation as well (Deci, 1991). Thus,

teachers' interactions with their social context (e.g., principals, colleagues, students, parents) will influence their participation in professional development and ongoing renewal (Dzubay, 2001).

In this section, I discussed several trends with regard to teacher motivation or willingness to learn and grow professionally. These trends include the importance of teacher intrinsic rewards, the differences in teacher personalities, intentions, and nature of willingness to learn, teacher competence, efficacy, autonomy, and beliefs, and teacher experiences in social contexts, their role in the community and leadership. Most of these factors can be divided into two categories: a) internal factors that influence teacher motivation to learn (e.g., self, personality, intentions, beliefs, competence), and b) external factors (social experiences, role in community, school environment, collegiality, leadership).

Research suggests that such external factors as workplace, school structure and culture, policy contexts, and social interaction influence teachers' sense of efficacy and professional motivation (Bredeson, Fruth, & Kasten, 1983; Johnson, 1990; Lortie, 1975; Rosenholtz, 1989; Rosenholtz & Smylie, 1984; Seashore-Louis & Miles, 1990). However, limited research is available to explain these influences (Smylie, 1988). Furthermore, factors associated with conditions, such as isolation or opportunities for informal interaction, "may have far greater potential than financial incentives as levers to improve schools by attracting and keeping excellent teachers" (Scribner, 1996, p. 240; also see Johnson, 1990). Thus, many external factors are not isolated. These factors interact and affect the internal factors of teacher motivation, and influence the overall processes of teacher learning (Smylie, 1988; Johnson, 1990; Scribner, 1996). Since the

above review of literature described many of the internal factors (e.g., teacher vision and beliefs, teacher knowledge and competence, teacher classroom practices, and teacher willingness or motivation to learn), it is important to examine the literature findings on the external factors, in particular the role of *contexts* (e.g., school, administration, district) and *community* that play significant and influential roles in teacher professional learning (Shulman, & Shulman, 2004).

Teacher Efficacy Theory

Over the last twenty-five years, *teacher efficacy* evolved as a research construct primarily from Rotter's (1966) *locus of control* theory and Bandura's (1986, 1997) *social cognitive theory*. However, the meaning and measures of teacher efficacy has been the subject of considerable debate among scholars and researchers. In this section, I describe these two theoretical constructs and connect them to the developing research on teacher efficacy.

Locus of control is defined as a motivational concept that refers to general control over outcomes, meaning the extent to which individuals believe that their actions have an affect on occurring outcomes (Rotter, 1966). For example, if it is believed that outcomes occur independently of a person's actions, then this belief represents a reference to external control, whereas if it is believed that occurrences are highly dependent on a person's actions, then this belief represents a reference to internal control. Moreover, people who believe they have little control over the outcomes also believe there is little they can do to alter them, but those who believe the outcomes are contingent on their actions believe that they are largely in control of the effect on these outcomes (Pintrich & Schunk, 2001).

Locus of control is suggested to affect learning, motivation, and behavior. Individuals who believe they are in control of their success or failures are more motivated to engage in learning, expend effort, and persist to overcome the difficulties (Pintrich & Schunk, 2001). An internal *locus of control* viewpoint, similar to White's (1959) effectance motive, suggests that individuals with an internal locus of control make greater efforts to attain mastery over their environment, which is indicative of *intrinsic motivation* (Deci & Ryan, 1985). *Locus of control* was found to affect behavior across different settings, and some suggest that locus of control varies between situations (Phares, 1976). Thus, even though locus of control is important, there is a great need to better understand the specific conditions that affect such *control* and the extent to which an individual's *locus of control* rests within the tasks and setting in which it exists (Pintrich & Schunk, 2001).

Bandura's (1986, 1997) theoretical framework of *social cognitive theory* is founded in three key assumptions: (a) reciprocal interactions among personal, behavioral, and environmental factors; (b) the relation of learning on motivation; and (c) enactive and vicarious learning. *Behavioral-environmental* factors are interconnected by the sequence of actions that are involved to direct individuals' attention and focus their learning on a specific goal. The behavior resulted in the process of learning alters the environment to re-adapt and correspond to individuals' learning goals (Pintrich & Schunk, 2001). The *personal-environmental* interaction can be described using the individual's sense of self-efficacy and how it alters the environment in which s/he exists. For example, if a person has learning disabilities (low sense of self-efficacy) then the learning expectations for this individual might be changed (typically lowered). On the other hand, in the *behavioral-*

personal interaction the individuals, based on their sense of self-efficacy (personal

factor), make choices whether to engage in tasks, chose the task difficulty levels, and

how much effort and determination to invest in the completion of the task. In contrast,

after working on a task and observing their progress (behavioral factor) individuals' sense

of self-efficacy may be enhanced (Zimmerman, 1989).

In social cognitive theory, *learning* is distinguished from *performance*. People

may learn from observation; however the knowledge and skills they acquire may not be

observable at the time of learning (Rosenthal & Zimmerman, 1978). In fact, "people will

not demonstrate skills until they are motivated to display them" (Pintrich & Schunk,

2001, p. 149). Social cognitive theory postulates that competence can be acquired without

ever being displayed; however, *motivation* affects both learning and performance, and

even though the two are separable, motivational inducement may grow and become

powerful during learning (Pintrich & Schunk, 2001).

In social cognitive theory, "Learning is largely an information-processing activity

in which information about the structure of behavior and about environmental events is

transformed into symbolic representations that serve as guides for action" (Bandura,

1986, p. 51). *Enactive learning* is learning by doing, where experiences from successful

actions are retained, and experiences from failures are discarded. *Vicarious learning*

derives from observing models both live (e.g., teachers, mentors) and symbolic or

nonhuman (e.g., media, printed materials, animated characters). Vicarious experiences

may accelerate learning by "saving" students from personally experiencing negative

consequences or performing every action that must be learned. Bandura (1986) contends

that behavioral consequences whether experienced personally or modeled, inform and

motivate individuals rather than strengthening their behaviors, as was suggested by Skinner (1953). For example, if failure is observed (personal or modeled) individuals will know that something went wrong and that corrective actions need to be taken. From a motivational standpoint, individuals learn actions or behaviors that they value the most, and believe those will lead them to successful outcomes. The widely practiced model of learning, *learning from models*, however limits the individual's learning experiences because complex-skill learning naturally occurs when both enactive and vicarious experiences are provided (Pintrich & Schunk, 2001).

Working with Rotter's (1966) *locus of control* theory, the researchers at the RAND Corporation[1] studying the effectiveness of reading instruction first conceived of *teacher efficacy* as the extent to which teachers believed they could control the reinforcement of their actions. Their primary research question was: Does control of reinforcement of teacher actions lie within the teachers themselves or in the environment? Students' motivation and performance were assumed to be major sources of teacher reinforcement, hence assuming that teachers, who believed they could influence students' achievement and motivation (internal locus of control), have a high level of efficacy.

A second conceptual strand of teacher efficacy theory grew out of the work of Bandura (1977), who identified teacher efficacy as a type of self-efficacy, which is an outcome of a cognitive process in which people construct beliefs about their capacity to perform at a given level of competence. These beliefs affect how much *effort* teachers will be willing to expend, how *persistent* they will be at overcoming the difficulties, how

---

[1] RAND Corporation (the name of which was derived from *research and development*) initially focused on issues of national security. However, 60 years ago RAND expanded to pursue nonprofit research in areas, such as business, education, health, law, and science.

resistant they will be at facing the failures, and how ready they are to *cope* with the stress and demanding situations along the way (Bandura, 1977).

These two models of teacher efficacy have sparked much debate and confusion among the researchers. Some educators assumed that Rotter's internal *locus of control* and Bandura's perceived *self-efficacy* are generally the same. In 1997, Bandura clarified the difference by noting that one's capability to produce certain actions (perceived self-efficacy) are not the same as beliefs about whether those actions affect outcomes (locus of control). Furthermore, perceived self-efficacy is a much stronger predictor of behavior than locus of control, because Rotter's internal-external locus of control is primarily concerned with *causal beliefs* about the relationship between actions and outcomes and not with *personal beliefs* about self-efficacy. For example, a teacher can hold a belief that she can increase student achievement but have little confidence in whether or not she can accomplish that goal (Bandura, 1977).

Furthermore, Bandura (1997) identified four main sources of information from which self-efficacy beliefs are developed: (a) enactive mastery experiences; (b) vicarious experiences; (c) verbal persuasion; (d) physiological and affective states. As discussed earlier, *enactive mastery experience* comes from learning by doing and *vicarious experiences* comes from learning by observing models, including self-modeling. *Verbal persuasion* refers to efficacy information gained from conversations about individual's capabilities to perform a particular task, whereas *physiological and affective states* reflect the information individual gains from physiological and emotive reactions to a particular task.

A third conceptual strand contains the integrated model of teacher efficacy, which is consistent with the social cognitive theory of Bandura (1986, 1977). However this model is substantially grounded in the claim that teacher efficacy is context specific, i.e. teachers do not feel equally efficacious in all teaching situations (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). For example, the integrated model suggests that teachers may feel efficacious teaching specific subjects, to specific students, in specific settings. Thus, teachers may feel more or less efficacious under different circumstances (Ross et al., 1996). The model also suggests that when researching teacher efficacy it is crucial to consider the teaching task, the context, and one's strengths and weaknesses in relations to the requirements of the task (Goddard, Hoy, & Woolfolk Hoy, 2000). This model has been referred to as a model of *collective efficacy*, an emergent group-level attribute, the product of interactive dynamics of the group members (Goddard, Hoy, & Woolfolk Hoy, 2000, p.482). This emergent quality is more than a collection of individual attributes, it is "the group shared belief in its conjoint capabilities to organize and execute courses of action required to produce given levels of attainments" (Bandura, 1997, p. 477).

Teacher efficacy, or teachers' belief in their ability to influence valued student outcomes, often had been confused with *teaching effectiveness*. It is imperative to regard that teachers' efficacy beliefs may underestimate, overestimate, or accurately reflect their actual teaching effectiveness, especially considering the measures currently available and used to research teacher efficacy. Teacher efficacy has almost always been assessed through teacher self-reports on one to 30 or more Likert-scale items, the questions of which usually address a range of teaching tasks and situations, and the scores from these questions are typically averaged across all the subscale items. Therefore, teacher efficacy

remains a conceptually elusive construct, which is difficult to assess with certainty (Hebert, Lee, & Williamson, 1998). However, it is important to learn about available measures of teacher efficacy and to understand their limitations.

Teacher Efficacy and Teacher Learning

Teacher efficacy has been used in multiple studies drawing on various definitions. A common finding, however, was that individual change in teaching practice is a direct function of personal teaching efficacy (Hoy & Woolfolk, 1993; Smylie, 1988). Research also suggests that since teacher efficacy immediately affects the amount of effort that a teacher expends and the persistence s/he shows in the face of teaching obstacles, teacher efficacy is a strong predictor of teacher continuation of professional development and learning (Berman & McLaughlin, 1978).

For mathematics education, researching teacher efficacy is especially critical, particularly in light of supporting teachers in realizing recent educational reforms regarding *Standards-based* teaching and learning classroom practices (NCTM, 1989; 2001). Numerous researchers have explored the relationship between teacher efficacy and successful school change and found professional development for teachers to be a critical component of meaningful reform (Darling-Hammond & Sykes, 1999).

Smylie (1988) suggested three categories of interrelated factors influencing change in individual teacher practice as a result of staff development opportunities: (a) teachers' pre-training psychological state, (b) characteristics of teachers' task environment (classroom), and (c) dimension of school context. Teachers' personal characteristics were found to impact their receptiveness to teacher development, yet social trust and teacher efficacy as personal characteristics related to teacher learning

outcomes were found to evolve from professional development efforts (Fisler &
Firestone, 2006).

Consequently, it has been claimed that it is necessary to recognize that teacher
learning includes more than just content and pedagogical knowledge; it also includes
changes in teacher attitudes and their habits of work that allows them to become more
effective in their classrooms (Loucks & Hall, 1979; Smylie, 1995). Thus, research on
teacher learning must be grounded on both affective and pedagogical learning
perspectives, and teacher efficacy should be at the heart of this research (Borko &
Putnam, 1995).

For many years, teacher efficacy has been irrefutably connected to student
achievement. In fact, the vast majority of researchers suggest that high teacher efficacy
predicts higher student achievement, whereas low teacher efficacy has a negative impact
on students' performance (see Ross, Hogaboam-Gray, & Hannay, 2001; Cannon &
Scharmann, 1996). It has also been found that higher efficacy classrooms are usually
represented by teachers who feel more prepared and by students who are relatively well-
behaved and of higher performance and ability (Gibson & Dembo, 1984).

However, one of the important contentions that must be asserted about current
research on teacher efficacy is its inconsistencies in the findings as well. For example as
mentioned earlier, several researchers argue that educational reforms, especially related
to new and innovative philosophies of teaching and learning, are difficult for teachers
particularly during their initial five years of implementation. Researchers reported that
teachers felt quite uncomfortable with their reform awareness and their abilities to use
innovative practices (van den Berg & Ross, 1999). Teachers were found to continually

resist educational changes, and express disappointment with not being able to manage the reform changes competently and losing the autonomy of their classrooms (Amit & Fried, 2002).

On the contrary, it has been argued that higher efficacy is associated with the use of more challenging teaching techniques and, most of all, with teacher willingness to try innovative instructional methods (e.g., Ghaith & Yaghi, 1997; Guskey, 1988; Rangel, 1997). It has been claimed that highly efficacious teachers are often found in schools characterized as having a low stress environment where teachers are active in collaboration. These teachers usually carried a joint commitment to collective learning goals (Warren, 1993) and symbolized a forward-looking flexible culture in the school districts.

Teacher efficacy studies reported a surprising relationship between personal and general teaching efficacy, teachers' years of experience, and gender. Teaching efficacy surveys established an inverse relationship between personal teaching efficacy (what I do) and general teaching efficacy (what any teacher does), suggesting as personal efficacy increases the general efficacy decreases (e.g., Soodak & Podell, 1996). Gender differences also have been consistently found to be a factor for increased teaching efficacy for female teachers, who were more efficacious (both personal and general) than male teachers (Woolfolk & Hoy, 1990). In regards to teachers' years of experience, it has been also found that overall teaching efficacy decreases as teaching years increase (e.g., Benz et al., 1992; Ross, 1994). However, unlike student learning, very little research exists that address the relationship between teacher efficacy and teacher learning, and factors that influence this relationship. Moreover, the with recent reforms being

extremely demanding on the teachers' schedules and learning experiences, it is unclear how teacher efficacy affects teachers' motivation to learn and teachers' coping mechanisms with the reform changes in their school and district's policy.

Educational Policy Research Related to Teacher Learning.

In this section, I review the literature related to the policy and educational reform analyses that is related not specific to mathematics education, but is related to teacher learning and professional development. Included in this section are sections on: a) educational research related to teacher learning in general; b) policy influences on teacher learning and participation in learning; and c) effective professional development research.

Policy and Teacher Learning

One of the most demanding and challenging policy contexts in which teachers must exist is related to the education act recently passed by Congress, namely "No Child Left Behind (NCLB)" Act (citation). A 1980's "traditionalist" attack on public education, undertaken during Ronald Reagan's presidency, morphed into the educational reform movement of the 1990s, and has been recently "transformed" into NCLB. As Year 5 of NCLB began, schools continue to yearn for annual gains in test scores, pushing all students to meet state-defined standards by the year 2014. At present all districts in the country are required to conduct testing in math and reading every year for students in Grades 3 through 8, and then once in high school. By the school year 2007-08, science tests are required as well. Thirty three million tests related to the mandates of NCLB are currently administered in public schools (Karp, 2006), and more than 11 million are on their way by the end of this school year. The consequences of failing to comply with

NCLB are high. Schools that do not meet annual yearly progress ultimately be taken over by the state, and reconstituted as charter schools, or operated by private, for-profit companies. There are many who argue that this is the point behind NCLB, to privatize public education. Moreover, Congress promised to fully fund the NCLB, however failed to keep that promise. In the past five years, more than 10,000 schools across the United States were on the "needs improvement list" and faced an "escalating series of sanctions that addressed neither their needs nor their challenges," (Karp, 2003, p. 2). This has left states and districts crumbling to find money to carry out the training, testing, scoring, and remediation provisions of the law (Selwyn, 2007).

Another aspect of NCLB Act is focused on improving teacher quality. This law requires that all teachers be "highly qualified" in the subject areas they are teaching. The law defines *highly qualified* mostly in terms of teacher subject matter knowledge. According to NCLB, teachers, to be highly qualified, must be certified by the state, have at least a bachelor's degree, and pass basic skills and subject area tests. This definition narrowly defines quality in terms of content knowledge and has led many states to employ paper-and-pencil tests as absolute gatekeepers (e.g. Praxis exams).

There are many other troubling aspects to this limited definition of *highly qualified teachers*. Research findings are mixed with regard to whether teacher academic abilities translate to achievement in the classroom as teachers. Serious weaknesses in the research and existing literature on teacher testing show that there is little or no agreement on what are the most effective approaches to teaching. Moreover, moral, ethical, and practical issues provide conflicting quandaries in considering the high-stakes role that testing plays in determining who can become a teacher (see Hill, Sleep, Lewis, & Ball,

2007; Wilson and Young, 2005). Cochran-Smith and Zeichner (2005) reported that more than 600 tests were used across the US to measure teacher' basic skills or content knowledge, and no evidence exists that this knowledge is predictive of who will become an effective teacher.

Despite its idealistic goals, NCLB has a substantial impact on teacher education, especially for practicing teachers who are currently working in public schools. It is affecting the *quality* and *nature* of professional development, the allocation of school or district resources, and the focus of teacher learning. If, in the past, teachers' concerns were about helping children learn, "now they are about raising scores, especially for those just below the passing mark" (Selwyn, 2007, p. 125). For example, many school districts, for various reasons, continue to prefer and sponsor "one-shot workshops," which are usually in the form of a lecture, a workshop, or a meeting. Ball (2002) stated, "We have had strong reactions to the waste of time, to the lack of engagement of useful knowledge, to the often-poor pedagogy or dramatic style of such sessions, ….yet many of us [professional developers] have ourselves offered such sessions" (p. 10). As a result, it is unquestionable that teacher learning, its merit and character, and teacher motivation to learn is enormously impacted by the *policy contexts* practiced by schools, districts, and nationally (Ball, 2002; Hill, Sleep, Lewis, & Ball, 2007; Wilson and Young, 2005; Selwyn, 2007).

Before I continue further, I will explain what I mean by contexts. *Contexts* are socially constructed, located frequently but not necessarily within institutions, but individually interpreted (Grossman & Stodolsky, 1995). Lave (1988) distinguished between arenas and settings in her description of context. *Arenas* are the larger socially

constructed institutions, which have certain set of features that both enable and constrain the activity within the arenas. However, a *setting* is individually constructed, represented, or interpreted version of the arena (Lave, 1988). The construct of a setting explains why individuals experience the same arena differently.

The organizational context of high schools has a direct interaction with subject matter because of the existence of subject-based departments (Talbert & McLaughlin, 1993). Departments were designed to powerfully influence the work and lives of secondary teachers (see Ball, 1981; Johnson, 1990; Siskin, 1994). School subjects, as arenas for practice, have different features, histories, and status that influence what teachers do (Goodson, 1985; Stodolsky, 1993). These features create implications for the nature of teaching within the subject matter and may support or hinder reform efforts and teacher development. Consequently teachers' work and professional lives are impacted by the beliefs and norms of other teachers who share a common school subject with them, and they can be viewed as existing within *subject subcultures* (Ball, 1981; Ball & Lacey, 1984).

Teachers' *work context* is subject-specific. Teachers may hold subject-specific beliefs related to teaching and learning and may have varied views they find problematic on particular issues and policies (Grossman & Stodolsky, 1995). *Work contexts* are multidimensional and different for every teacher. For example, Eraut (1994) distinguished among three contexts of teacher professional learning in the work context: a) academic, b) school, and c) classroom. The *academic context* is prevalent to all professions and generally contains theoretical knowledge communicated through

specialized language. Teacher's knowledge, for instance, may include curriculum knowledge or subject matter knowledge that s/he acquired from coursework.

School context is the unique organizational environment that is particular to the teacher and other stakeholders at that school. Members of this organizational environment socialize through a special type of knowledge that is contextual and particular to organizational norms, policies, and procedures that guide members, their behaviors and conducts, and provide organizational directions. *Classroom context* is a place where teachers "on the fly" decide on the courses of actions, without much time to reflect on past knowledge or memory. This type of knowledge is spontaneous and has important implications for classroom practice (Jackson, 1968).

Another type of context that influences teachers' professional growth is *community context*, in which teachers exist and learn. Arbaugh (2003) provided evidence that four of seven teachers in her study group meetings valuing their learning in study groups because these groups provided them opportunities to build community and collegiate relationships with other teachers in the group, Moreover, "All seven teachers commented that they learned from hearing other teachers in the study group discuss implementing specific tasks in their classrooms" (Arbaugh, 2003, p. 152).

Situated cognition and the notion of *communities of practice* (Lave & Wenger, 1991; Brown & Duguid, 1991) represent a new way of considering and conducting professional development. In these models, teachers' role is not the "receivers" of professional development, but rather "partakers" of the professional development as their everyday activity (Moore & Barab, 2002). Wenger (1998) described communities of practice as:

The primary focus of this theory is on learning as social participation. Participation here refers not just to local events of engagement in certain activities with certain people, but to a more encompassing process of being active participants in the practices of social communities and constructing identities in relation to these communities... Such participation shapes not only what we do, but also who we are and how we interpret what we do (p. 4).

The phrase "community of practice" suggests that the opportunity to engage in practice with others and to involve whole persons, and not simply individual minds, is critical to the learning process (Barab & Duffy, 2000). It also involves sustained relations over a period of time among community members and contexts in which they function.

Unfortunately, the nature of schools and schooling today makes such an approach to professional development difficult to realize. Teachers rarely have the opportunity to share, discuss, and reflect on each others' teaching. School schedules rarely allow them to view their colleagues in action. Thus, the "practices" that most teachers form communities around rarely include teaching itself, but more likely are generated around administrative work or social groups and activities (Moore & Barab, 2002). Additionally, especially in upper grades, a building or a smaller district may only have one trigonometry teacher, which is detrimental in his or her learning as part of a community.

Policy Influences on Teacher Learning.

From the above described research it is evident that policy influences all educational contexts where teaching and learning occurs. In this section, I provide additional research on the influence policy has on teacher learning specifically.

In their recent study Desimone, Smith, and Phillips (2007) examined the influence of policy on teacher's participation in professional development. The authors suggested that besides the immediate impact of school and teacher characteristics on

teacher learning, several policy attributes also directly influence professional development of teachers. These include: authority, power, consistency, and stability within the schools and the districts in which the teachers are working.

The authors define *authority* as an attribute involving two levels: school level authority and classroom level authority. At the school level authority includes teacher's reports and perceptions of how much influence they think teachers in their school have over school level policies. At the classroom level authority reflects teacher perceptions of their level of control over classroom practices. The third description of authority describes principal's perception and report of the degree to which teachers take leadership roles in designing and implementing professional development activities, or how often professional development is planned and presented by teachers.

Power was defined as an attribute that closely interacts with sanctions that are associated with a school's policy environment. For example, principals' policies and practices at the school, especially related to "teacher dismissal", meaning dismissing poor or incompetent teachers, inadequate teacher assessment documentation, tenure, teacher associations and organizations, and how often the school and the district supervised and evaluated their faculty and staff.

Consistency was identified to interact with policy environment related to how well the content of professional development for teachers is aligned with school-, district-, and state-level policies. And last attribute, *stability*, which represents the extent to which people, circumstances, and policies remain constant over time. For example, the frequency of principal and teacher turnover at the schools.

The authors concluded that authority and stability play more of a role than power and consistency in moving teachers into taking high-quality professional development, specifically, professional development that focuses on content or teacher strategies, and/or that involves interactive learning. The only notable difference was found between math and science teachers, in that authority played more of a role for math teachers than for science teachers, specifically, related to involvement in school policy and teachers planning and presenting during professional development. These results were related to math teachers taking more content-focused professional development, but not to science teachers.

The authors also concluded that teacher involvement through persuasion (rather than power), meaning active participation in planning, building buy-in through participatory management, is associated with more participation in "effective" types of professional development, which is consistent with previous literature suggestions (see Elmore, 1993; Floden et al., 1988; Loucks-Horsley et al., 1998). Additionally, the authors concluded that power has a reverse affect on teacher learning, "When principals report more evaluation of teachers based on their teaching and their students' achievement", both math and science teachers report taking less content-focused professional development. This implies that the threat of evaluation may serve as a disincentive for teachers to seek out challenging learning opportunities (p. 1114). Furthermore, unlike consistency, teacher stability proved to be significantly associated with teachers' participation in both content-focused and instruction-related professional development for math and science teachers. Thus, teachers are more likely to invest in their own learning

if they are attached to a school and feel a sense of community, which is more likely when

the same teachers spend more time at the same school (Louis & Marks, 1998).

Effective Professional Development

Considering the recent research studies on effective professional development, it

is evident that, "Change in teaching would occur if teachers experienced consistent, high-

quality professional development" (Desimone, Porter, Garet, Yoon, & Birman, 2002, p.

105). Powerful teacher education programs must be based on knowledge about students

and teachers.

For example, a professional development program must address issues on how

students learn and what students need to know. Moreover, effective professional

development must also be structured to focus on how teachers learn, and what teachers

need to know to be able to educate their students. Recent studies suggested that,

"successful reform requires acceptance and adoption by teachers" (McCaffrey et al.,

2001, p. 493). In order for teachers to implement their learning into teaching, a

professional development program should motivate teachers, individualize professional

growth plans, and respond to teachers' personal and intrinsic needs (Belcastro &

Isaacson, 1992; Bolin & McConnell-Falk, 1986; Bradley, 1996).

It has also been strongly advocated for university personnel to consider the unique

context of teacher education when planning professional development programs,

especially for inservice teachers. Teacher educators must understand students and

classroom teachers' needs and expectations, their learning processes, and educational

contexts. Lee (2005) also suggested that a professional development designed in

collaboration with classroom teachers, teacher educators, administrators, and the greater

community (e.g., parents) is more effective. Thus, many theories, assumptions, and claims have been made about what constitutes effective professional development, but there is very little research that supports these claims and assumptions, especially in relationship to teacher learning specifically.

However, in their recent study, Garet, Porter, Desimone, Birman, and Yoon (2001) presented the result from the study that used a national probability sample of 1,027 mathematics and science teachers to provide the first large-scale empirical comparison of effects of different characteristics of professional development on teacher learning. The results of their study indicated that the type of activity used in professional development has an important influence on duration of the professional development, meaning that reform activities tended to span longer and to involve greater numbers of contact hours than such traditional activities as workshops.

The results indicated that duration-time span of the professional development and contact hours have a substantial influence on the teacher professional learning experiences. For example, time span and contact hours have a significant positive influence on teacher opportunities for active learning and coherence (have meaningful connections between one another, in other words, form a coherent part of a wider set of opportunities for teacher learning and development). This indicates that longer activities tend to involve more opportunities for active teacher learning, such as: planning for classroom instruction, implementing a lesson or unit, observing teaching, and examining students' work. Longer activities also tend to promote coherence by making connections between teachers' goals and experiences, alignment with standards, and professional communication with other teachers. Time span and contact hours also were found to

affect the quality of professional development, especially related to content-specific

mathematics learning of teachers. Professional development was likely to be of higher

quality if it was both sustained over time and involved a substantial number of hours.

The authors also found that both content focus and coherence have substantial

positive effects on enhanced teacher knowledge and skills. In particular, professional

development that enhanced teachers' knowledge and skills was largely focused on

mathematics content, connecting it to other teachers' learning experiences and the reform

efforts related to teaching. As a result, teachers' enhanced knowledge and skills also had

a substantial positive influence on change in their teaching practice. However,

professional development that was content focused, but did not increase teachers'

knowledge and skills, had a negative association with changes in teacher practice.

Moreover, the coherence of professional development had a significant positive influence

on change in teaching practices on top of the effects of knowledge and skills. Teachers,

who experienced professional development that was coherent, that is connected to their

other processional development experiences, aligned with the standards and assessments,

and fostered professional conversations between teachers, was more likely to change their

teaching practices.

In summary, the authors concluded that at the core of the effective professional

development are several important features: a) focus on content knowledge, b)

opportunities for active learning, and c) coherence with other professional development

experiences (p. 916). In accordance with this research, the National Staff Development

Council (2001) proposed a set of Standards for Professional Staff development. These

include context, process, and content standards. The *context* standards involve

opportunities that help improve student learning by creating learning communities of adults with shared and agreed upon goals and policies, guiding teachers' instructional improvements through district and school leadership, and supporting teacher learning by providing resources for their professional needs and development. The *process* standards involve opportunities that help improve student learning by prioritizing and monitoring teacher learning based on segregated student achievement data, guiding teacher improvement and impact by using multiple sources and evidence, making teacher learning more effective and successful by using research-based decisions (especially regarding human learning), designing professional development to fit and address the learning styles and goals of the teachers, and providing knowledge and skills to ensure collaboration. And *content* standards, that involve improving student learning by preparing teachers, who understand and appreciate all students, and create equitable and supportive learning environments along with high expectations for their academic achievement. The *content* standard also calls for deeper content and pedagogical knowledge of teachers to be able to help students meet rigorous academic standards, and teacher ability and competence in brining on board families and other stakeholders for academic involvement.

Summary

In this section, I described the major trends associated with teacher learning. From the review of literature it is clear to see that teacher learning and the ability to acquire and use knowledge are highly dependent on different contexts of learning and professional development. That is, for knowledge to be acquired, it must be used in some form, or

become a part of the user. As Wilson (1993) noted, "learning and knowing are integrally

and inherently situated in the everyday world of human activity" (p. 71). As the

knowledge gets acquired and utilized, it changes, and becomes increasingly personalized.

Personal knowledge is considerably shaped by teacher's beliefs, knowledge, experiences,

motivation, and, most importantly, school and district context in which it has been and is

intended to be used. Transfer of knowledge between contexts is limited by different

constrains in which that knowledge has to be available in order to be used (Scribner,

1996; Eraut, 1994).

In this study, I approached teacher learning and development as a structural model

of *six* clusters proposed by the framework (Shulman & Shulman, 2004):

a) *cognitive* cluster consist of discerning, understanding, ad analyzing;

b) *dispositional* cluster includes envisioning, believing, and respecting;

c) *motivational* cluster contains willing, changing, and persisting;

d) *performance* cluster embraces enacting, coordinating, articulating, and initiating;

e) *reflexive* cluster includes evaluating, reviewing, self-criticizing, and learning from
   experience;

f) *communal* cluster includes deliberation, collaboration, reciprocation, scaffolding,
   and distributing expertise.

I used the reviewed literature in several ways. First, the mathematics teacher

education literature helped me better understand the underlying principles of teacher

learning currently available, researched, and considered by the administrators, researchers

and teacher educators. It helped me in identifying the gaps within currently available

mathematics education research and guided my decisions in regard to formulating

research questions and developing the data collection instruments. Second, both the policy and educational psychology research helped me better understand certain levels and characteristics of teacher learning that are typically overlooked and not considered in the mathematics education research on teacher learning, such as district and school policy context, teacher professionalism, teacher motivation to learn, and teacher efficacy. Therefore, this literature review not only has helped me in better understanding the topic at hand, but, most importantly, guided the design, research questions, and the instruments of the study.

CHAPTER 3: METHODOLOGY

Research Tradition

Within the past 30 years educational researchers such as Campbell (1978) and

Cronbach (1975) have challenged scholars to transcend the limits of positivism and

quantitative research methodologies. To address these challenges many scholars

examined the literature and research methodologies in other disciplines, such as human

ethology, ecological psychology, holistic ethnography, and cognitive anthropology. Many

of these scholars posited that there was only one alternative to traditional positivism (e.g.,

Jacob, 1982; Lutz & Ramsey, 1974), while others acknowledged the existence of more

than one alternative, but referred to these alternatives collectively as *qualitative research*

(Bogdan & Biklen, 1982; Lincoln & Guba, 1985; Patton, 1980).

These research paradigms generally divide the scientific community. In his book

on the structure of scientific revolutions, Kuhn (1970) stated that within the sciences

there are various groups of scholars who agree amongst themselves on the nature of the

universe they are examining, on legitimate questions and problems to examine, and on

legitimate techniques to seek the solutions to those problems. Such a group is said to have

a "tradition" (Jacob, 1988). In this case, the "tradition" has been to side with either the

qualitative or the quantitative research advocates.

By tradition, *qualitative* researchers gather data through in-depth interviews,

video and audio recordings, observations, analysis of written work, and field notes. Such

data allows them to carefully document participants' behavior, experiences, and

viewpoints. However, qualitative researchers must observe objectivity when describing

participants' viewpoints and must keep in mind the context or setting in which the research is being conducted because this has an important influence on the research data (Bogdan & Biklen, 1982; Lincoln & Guba, 1985; Patton, 1980). The participant sample is rather small and selective, and true objectivity is almost impossible to achieve due to our strong predispositions to process information and the complex nature of our thoughts. Hence, both research paradigms have limitations, yet both can achieve robust and valuable research results if utilized with discretion.

On the other hand, at the heart of *quantitative* research is the investigation of the relationships between quantitative structures and phenomena. The goal of quantitative research is to develop and employ mathematical models, theories, and hypotheses relevant to these structures and phenomena. Quantitative research is grounded in the process of measurement, which provides connections between empirical observations and mathematical models of real world relationships. The sample is typically larger (than that of a qualitative study) and is expected to be random to minimize the influence of the context or setting. However, randomized sampling is almost impossible to achieve when collecting real world data (Kuhn, 1996). Thus, both research paradigms are imperfect, yet both must be considered depending on the type of research question being investigated.

My personal research practice (and belief) differs from the long-standing convention of choosing either qualitative or quantitative research exclusively. Methods must be carefully chosen to appropriately address the research questions of the study. I consider that, "The world is as many things as there are ways to describe it" (Goodman, 1978). Thus for this study, I developed and selected the research procedures, instruments,

and methods to be able to collect and analyze data for the purpose of appropriately addressing my research questions.

My study involved researching a single district. Thus, the collected data is not only particular to this district; it is influenced by the settings and the educational and political context of the district. Therefore, it is a *case study* of one district. Case studies are a form of qualitative descriptive research that is employed to investigate individuals, a small group of participants, or a group as a whole (Davey, 1991). The case study methods must include procedures that allow collection and presentation of detailed information about the particular group of participants, including the account of the subjects themselves, and drawing conclusions only about that group of participants and only in that specific context (Armisted, 1984). In my study, these participants are secondary (grades 6-12) mathematics teachers from one particular district. More specifically, my research goal was to investigate this district's secondary mathematics teachers' experiences and voices about mathematics professional development and specific influences that impacted these teachers' professional learning.

Since teachers' descriptions of experiences and perceptions about professional development are not readily quantifiable, it was appropriate to use qualitative methods, such as individual interviews, to collect the majority of my research data. However, since the participant sample consisted of mathematics teachers with different backgrounds, years of experience, coursework preparation, grade levels, curricula materials, and different hours of professional development, it was also appropriate to collect descriptive quantitative data to account for these differences; however no quantitative methods of data analysis were employed.

In addition to the differences in the participant sample, I realized that my participants may also be different in the way that they perceive learning and its purpose, the way each of them experienced learning (within the same event), and in the way that they describe learning experiences. Thus, I sought to utilize a methodology that allowed me to account for these differences. I found that the different ways of experiencing a certain phenomenon, largely influenced by categories of description that, in turn, represent different capabilities for dealing with that phenomenon, lie at the heart of *phenomenography*. Phenomenography is the empirical study of the differing ways in which people experience, perceive, apprehend, understand, and conceptualize various phenomena and aspects of these phenomena in the world around us (Marton, 1994).

Phenomenography is not phenomenology. Both phenomenography and phenomenology center on human experience. However, phenomenology is a philosophical method, with the philosopher engaged in investigating a phenomenon or his or her own experience with the phenomenon. Phenomenographers, on the other hand, adopt an empirical orientation to investigate the experience(s) of others (Marton & Booth, 1997). In other words, at the core of phenomenography are the experiences of others and their consequent perceptions of the phenomenon (Marton & Booth, 1997). Thus, to research teachers' experiences, descriptions, and perceptions of professional learning (through their eyes as the learners) my goal as a researcher-phenomenographer was to understand and focus on similarities and differences between the ways in which the phenomenon (professional development and learning) appeared to my participants (Marton, 1996).

Phenomenography's *ontological* assumptions are subjectivist, "The world exists and different people construe it in different ways" (Marton & Booth, 1997). The *theoretical perspective* of this study lays in a somewhat different epistemological standpoint in contrast to other learning perspectives. Phenomenography does not view learning in terms of mental models (e.g., cognitive science) or as social formation (e.g., situated cognition). Instead it draws upon *notion of intentionality* to characterize a *non-dualistic* model of experience, "There is only one world, one that is ours, and one that people experience in many different ways" (Brentano, 1973). Within the scope of the research questions and the methodology, this study was identified as a *basic (not applied) exploratory* study, thus no hypothesis was assumed or tested. In conclusion, the research methodology employed in this study involved phenomenographic case study of one district.

Purpose and Research Agenda

I believe that any researcher, regardless of the nature of his or her research (quantitative or qualitative), must have a purpose for conducting a study. The purpose for conducting my study was to contribute to the scarce literature on mathematics teachers' experiences with professional development, and to better understand and shed additional light on the urgent concerns about the aspects influencing teacher learning and their involvement in professional development. After reviewing the literature on mathematics teacher professional development and identifying gaps, the research agenda for this study was to:

a) appropriately gather and analyze the needed data,

b) obtain and fathom the results from data analyses, and

c) accurately extract and deduce inferences from the results to be able to draw appropriate conclusions.

Research Context

District

This study was conducted at a mid-size school district located in a Mid-western part of the country, comprised of about 16,700 total students (nearly 11,000 students in grades 6-12), and about 1400 teachers, with over 75 middle and high school (grades 6-12) mathematics teachers. Student population includes: 68% White, 23% Black, 6% Asian, 4% Hispanic, with 34% of students enrolled in a free or reduced lunch program. Student graduation rate is 85%, with a dropout rate at 4%. The total percentage of students taking the American College Testing (ACT) Exam is 70%, with a composite score of 23.8. Total expenditure of the district in 2008 reached $238,985,541, with expenditure per average daily attending (ADA) pupil being approximately $10,000. The operating district costs are covered by: 63% from local communities and counties budget, 30% from state budget, and 7% from federal funds.

In this district, the average student per teacher ratio is 12:1 and the average student per classroom ratio is 18:1. Over 55% of teachers have a master's degree with an average teaching experience of over 12 years. Almost 97% of all district teachers have Regular Teaching Certification (including Life Certificate, Professional Class I & II Certificate, Continuous Professional Certificate (CPC), and Provisional Certificate). About 3% of all district teachers have temporary or special assigned certificates, and only

0.6% of teachers either has no teaching certificate or has an expired or a substitute certificate.

Mathematics professional development

In this study the participating mathematics teachers represented eight schools total (2 high schools, 3 junior high schools, and 3 middle schools). In the past decade, this district has undergone the adoption and implementation of newly developed reform mathematics curricular programs: the Connected Mathematic Project (Lappan et al., 1996) at the middle school level, and the Core-Plus Mathematics (Coxford et al., 1998) at the high school levels.

The secondary (grades 6-12) mathematics teachers were provided with district-sponsored mathematics-specific professional development (PD) and consistently participated in these PD opportunities. These opportunities included: (a) PD designed to support teachers implementing Connected Mathematics at grades 6-8; (b) PD designed to support teachers implementing Core-Plus at grades 8-12; (c) Professional Learning Team meetings at some district schools (1 high school, 2 junior high schools, and 1 middle school); (d) 2-3 days of PD during early release time at all district schools; and (e) academic-year, district-wide PD meetings led by the mathematics district coordinator.

Participation of teachers in professional development, however, varied depending on the times of PD available. A high percentage of mathematics teachers participated in PD that occurred during their contract hours (especially when attendance was strongly encouraged), but the percentage of teachers that participated in professional development outside of their contract hours (e.g., after-school, on Saturdays, or in the summer months) was much smaller. Those who participated in professional development outside of their

contract hours received either in-service credit (which teachers can use to move up on the salary schedule), or a monetary stipend to compensate teachers for time spent in PD. Nonetheless, records demonstrated that only about half of 6-12 grade mathematics teachers took full advantage of district-sponsored PD held outside of their contract hours.

More specifically, attendance records from the past 4 years revealed that over 130 hours of PD (outside of contract time) was made available for teachers of grades 6-8, focusing specifically on curricular implementation of the Connected Mathematics Project. However, district records showed that (out of 35 teachers) only about 45% committed to this opportunity regularly, about 20% attended on a sporadic basis, and approximately 35% either rarely attended or did not attend at all. Similarly, from 2002-2005, the district offered over 200 hours of PD on the implementation of Core-Plus Curricular Materials for approximately 50 secondary teachers (grades 8-12). Of those teachers, about 40 taught at least one Core-Plus Mathematics Course. The highest attendance records indicate that only half (26) of the teachers attended these PD opportunities, and when the records were examined further it was revealed that these teachers only attended 75% of the total available PD opportunities. The attendance of the other teachers was either sporadic or absent at all times.

Moreover, teacher survey results indicated that teachers were not satisfied with the opportunities available for collaboration with other mathematics teachers within the timeframe of their workday. Over 52% of the teachers marked 'disagree' or 'strongly disagree' when asked to respond to the prompt, "There is adequate time during the day to support collaboration among faculty" (District's Secondary Mathematics Taskforce Report, 2007). In addition, in the past few years the district hired many new and young

mathematics teachers (especially for grades 6-12). In fact between years 2006-2007 the total number of the district's teachers with 0-5 years of experience had grown from 300 to 320, comprising 25% of the total teacher population and dropping the average years of teaching experience from 15 years to 12.

Participants

Thirty-five (9 male and 26 female) middle and high school mathematics teachers participated in this study. Teachers were introduced to the study and were selected on the basis of their voluntary participation. All teachers who agreed to participate were added to the study as participants and were subsequently interviewed. Twelve of these teachers had less than 5 years of teaching experience; the remaining (23) teachers had more than five years of teaching experience. Twelve participants were high school mathematics teachers (from 2 high schools), another twelve teachers were from three junior high schools of the district, and the remaining eleven teachers were teaching at the three middle schools in the district. Among these mathematics teachers, five were also department chairs (see Appendix A).

Three of the thirty-five teachers were also certified in special education, and taught mathematics either as a "class within a class" or had their own individual classrooms. These three special education mathematics teachers were from the three junior high schools in the district (one at each school). However, due to the nature of the differences between regular and special education mathematics and related professional development opportunities available in the district, the responses of these teachers were vastly different from the rest of the sample, and were not included in this project. Thus,

the findings reported in this study were based on the responses from the thirty-two 6-12 grade mathematics teachers.

In addition to the interviews of mathematics teachers, I conducted one interview with the district coordinator for middle and secondary mathematics curriculum and professional development. The district coordinator provided details about the district and its vision, information about mathematics teachers' participation in professional development, and the type of professional development opportunities that have been available in the past 5 years.

Informed Consent

To gain access to the schools I first contacted the district's main office to explain the goals of this research and seek written approval to work with the district's 6-12 grade mathematics teachers and the district middle and secondary mathematics coordinator. After obtaining written approval from the district, I contacted mathematics department chairs at each school, asking to visit their department for 10-15 minute to explain the goals of the research and invite mathematics teachers to participate. The department chairs at each school responded positively and scheduled an appointment for me to come during one of the department meetings. During these meetings I met with the mathematics teachers, explained the goals of the research study, and distributed two copies (per teacher) of the consent form for them to mark with a signature their choice of participation ("I agree" or "I disagree") and return one copy back to me, keeping the other copy for their personal records (see Appendix B)

Originally forty-two teachers agreed to participate in the study. However, due to various reasons, seven of them declined on the same day of the meeting and the signing the consent form. Two of these seven teachers asked me specifically not to disclose to their department chairs information about their declining participation.

Design of the Study

Role of the Researcher

My role as a researcher was the following: a) to formulate and design this study, b) obtain written approval and consent from all participating institutions and human subjects, c) develop instruments for data collection, d) collect the data, e) analyze the data, f) report the findings, g) draw conclusions based on these findings, and h) to offer possible directions for future research. In the following sections I describe in details the abovementioned aspects related to my role as a researcher.

Data Sources: 6-12 grade Mathematics Teachers

Three data sources will be used to address the research questions: a) teacher surveys (Appendix C); b) data gathered from the mathematics district coordinator about teachers' attendance records (high attendance 70% and more, and low attendance 30% or less) for district-sponsored professional development; c) teachers' individual one-hour interviews (Appendix D); d) interview with the mathematics district coordinator (Appendix E)

Teacher Surveys provided two types of data for this study: general and specific. *General* data included the following: the number of teachers (both female and male) in the study, the number of years of experience, the school and the grade level taught, the

curriculum used, the number of hours of attendance of professional development, and teachers' background information including education, teacher preparation, and demographic data. It also included general questions (and rankings) about the district-sponsored professional development made available for these teachers. Most questions were multiple choice, including several that were in Likert Scale format to address teachers' rankings of district-sponsored professional development. These questions were placed at the front-end of the Teacher Survey. The purpose of collecting these data was to be able to better describe the participants and to identify commonalities and differences among them. This data source provided a foundation for the follow-up interview with teachers, based on their responses to the Teacher Survey. It served as an initial stage of obtaining teacher responses to address all three of the research questions.

Specific data collection was adapted from the Horizon Research Institute to address two major purposes of the study: a) to focus on the research questions and b) to mirror the literature and the conceptual framework of the study. In particular, it was developed to collect qualitative (non-multiple-choice) data on teacher learning through professional development, their perception of professional development, and their participation in professional development. It was also developed for the purpose of collecting data related to the *three* levels of teacher learning suggested by Shulman & Shulman (2004) in the context of professional development: as individuals, in a community setting, and in a policy context. These data were collected via open-ended questions. Several questions targeted teachers' perception of professional development within the *individual* teacher-learning framework:
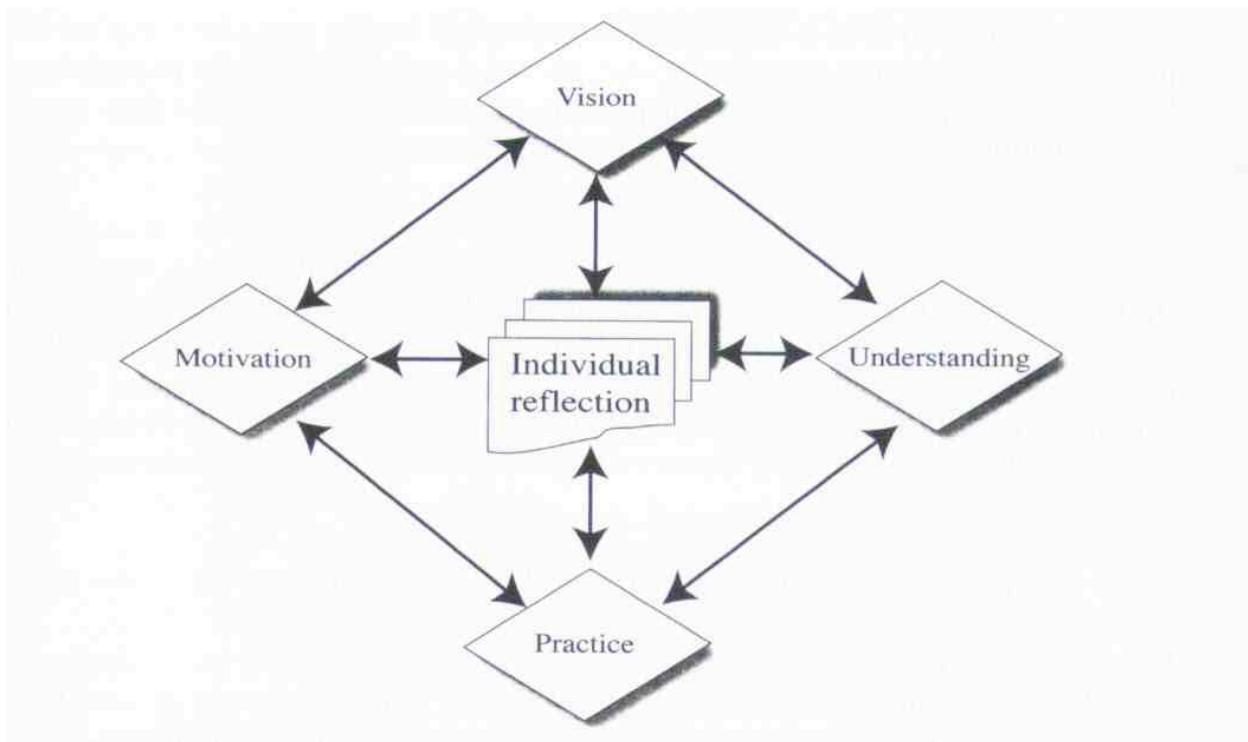
Figure 3.1 Teacher Learning at the Individual Level (Shulman & Shulman. 2004, p. 266)

For example, I asked teachers, "If you were to design an 'ideal' professional development to help you, as a teacher, learn mathematics. What would it include?" These questions addressed the research questions in greater depth than Teacher Survey, obtaining and following up on teachers' insights about learning mathematics as a content; specific strategies they use to learn mathematics; teachers' beliefs about the nature of mathematics; and teachers' motivations for learning mathematics as a content

In addition, the *specific* survey data were collected to target specific areas, such as: the school setting in which these teachers taught, collegiality and peer support, district professional development resources, and policy vision of the district. These questions were placed at the end of the Teacher Survey and served the purpose of

collecting a first round qualitative data, and addressing the research questions specifically related to teacher learning at the policy level.

The purpose of *Individual Teacher Interviews* was twofold: a) to follow up on the *specific* questions of the Teacher Survey, and b) to probe deeper into the learning characteristics, needs, concerns, and suggestions of the participants. The follow-up questions during the interview were intended to probe further with *how?* and *why?*. For example, in the Teacher Survey I asked, "If you were to design an 'ideal' professional development, what would it include?" The follow up questions included, "Why do you think so? How (in what way) do these features make it 'ideal' for you? What else do you think also would benefit your learning?" Every *specific* question on the Teacher Survey was followed up with these types of questions in the interview.

The second part of the interview focused on providing the teachers with opportunities to describe themselves as learners, talk about the *best* and *worst* professional development learning experiences they had in the past, and offer suggestions on effective ways for the district to help these teachers' in their professional growth. In addition, the interview also included a range of questions focusing on teachers' reasons for attending and not attending professional development opportunities and what they value the most, the sources and ways that teachers learned about the availability of professional development opportunities, and additional ways that they learned about opportunities outside of district-sponsored professional development. Each interview was at least one hour long and was audio recorded for verbatim transcription and subsequent analysis.

The last data source was an interview with the district coordinator, who was in charge for implementing the district's decisions related to middle and secondary mathematics instruction, curriculum, assessment, and teacher professional development. As a part of the interview, the district coordinator provided information about teacher attendance at district-sponsored PD. The purpose of collecting these data was to compare and verify the self-reported teacher data on their backgrounds and attendance of district-sponsored professional development. I provided the district coordinator with a spreadsheet to fill out that had the names of *all* grades 6-12 mathematics teachers in the district (to maintain confidentiality of those teachers who chose to participate in the study). Based on the district's records of teacher attendance at professional development, he ranked the teachers by *high* or *low* attendance: high being the teachers who attended 70% or more of the district-sponsored professional development (in accordance with their teaching experience in the district) and low being the teachers who attended 30% or less of the district-sponsored professional development. After he filled out the spreadsheet, I discarded the information about the teachers who did not participate in the study.

I conducted one interview with the middle and secondary mathematics district coordinator, Richard (Rich). The interview questions focused on the district's vision of mathematics and pedagogy, and, most of all, focused on the design, implementation, and opportunities available in district-sponsored mathematics professional development. The duration of the interview was one hour, during which the entire interview was audio recorded for verbatim transcription and analysis. The purpose of the interview was twofold: a) to gather detailed information about the district-sponsored mathematics professional development that was offered in the past five years, and b) to triangulate and

compare the teachers' and the district's visions and responses about professional development, and also about philosophy of teaching mathematics, and the nature of teacher professional learning.

Data Collection and Procedures

In the case study approach to research various procedures are implemented to examine and to describe the actions, perceptions, and behaviors of the participants in the study. Those include direct or participant observations, archival documentations, field notes, interviews, and artifacts. In phenomenographical approach to research however, the individual interview has been identified as *"the dominant method for collecting data"* (Marton, 1981). Since teachers' individual perceptions about professional learning are at the heart of this research study, for the purpose of the study, *individual interview* was the main method for data collection. The data collection took place between September 2007 and January 2008.

Before school began, in early August 2007, I submitted the application to conduct the study to the district's main office as well as the Institutional Review Board (IRB) of the University of Missouri. After approximately six to seven weeks, both institutions granted the approval to conduct the study. As soon as the research study was approved, I contacted the mathematics district coordinator and mathematics department chairs via email about my study. The mathematics district coordinator agreed to participate in the study immediately. The mathematics department chairs represented eight schools (3 middle schools, 3 junior high schools, and 2 high schools), and also seemed enthusiastic about the study. I asked each chair for a possible visit during their next department meeting to talk to the mathematics teachers about my study and to request their

participation. All department chairs agreed to participate and scheduled a time for me to visit their department meetings. During each of the department meetings I met with the mathematics teachers, explained the goals of my research study, and distributed the consent forms for the teachers to mark with a signature indicating their choice of participation. Teachers did not receive any incentives for their participation in the study.

Before the interview, I asked each teacher to complete the Teacher Survey so that we were able to follow-up on teacher responses during the interview. Every teacher complied with that request. Some typed their responses, some wrote them by hand. In order to be able to transcribe and analyze complete interview data, I asked (in the consent form) that teachers allow me to audio record each of their interviews. All thirty-five teachers agreed to this condition. I asked the district coordinator to audio record his interview, and he agreed to do so as well. The interview with the district coordinator took place in his office at the district building. All (but one) teachers also preferred their interviews take place in their office or in a classroom (at the school). Only one teacher's schedule was overly busy; thus I scheduled a phone interview with this teacher. All interviews, including the phone interview, were audio recorded and transcribed verbatim.

Data Analysis

Unit of Analysis

Typically, in case studies the unit of analysis is the individual case that is being investigated. In this study, ultimately, the unit of analysis was the district and the findings of the study were reported from a perspective of analyzing mathematics teachers representing a single district. However, the teachers in this district had different

backgrounds and preparations, teachers taught in separate classrooms to diverse student population using different curricular materials, and teachers worked in different schools and building. As a result, to better understand and analyze a school district holistically, I needed to consider many different contexts, factors, and components that shaped this district as an entity, and, most importantly, I needed to analyze the contexts, factors, and components that affected the teachers in this district and their professional development. Therefore, the process of unitizing the data analysis into smaller units (building blocks) was necessary to reach the ultimate goal of considering the district as a unit of analysis.

Likewise, in phenomengoraphy, Marton (1981) suggested, as the interviews are transcribed verbatim and the analysis has begun, the researcher's focus must be unmistakably positioned on "similarities and differences between the ways in which the phenomenon appears to the participants. As the same participant may express more than one way of understanding the phenomenon, the individual is not the unit of analysis" (p. 183). I followed the suggestion of *not* considering the individual as the unit of analysis. As described above my unit of analysis changed as I analyzed data, even regarding individual teachers. For example, throughout my *formative analysis,* as I moved away from individual quotations into the theme tracking, memo writing, categorizing, and conceptualizing the findings, each individual teacher became part of larger domains, such as: practitioners, department chairs, mathematics coaches, and novice or experienced teachers. Thus, throughout the data analysis, the unit of analysis was not set to be fixed or permanent, however, ultimately, for the purpose of the study, the multiple data analyses collectively merged to frame and outline one district as a whole.

Marton (1981) also suggested abandoning the boundaries that separated individuals, and to instead join their transcripts together. However, I did not join participants' transcripts together for two reasons. First, for the purpose of this study, I sought a diverse sample of teachers, in terms of their characteristics, backgrounds, personalities, and professional development attendance, to be able to depict a bigger picture in terms of the differences (in both the depth and the breadth) of these teachers' professional development experiences as a district. Second, the research goal of this study was not only to document these teachers' experiences, but also to examine whether their backgrounds, characteristics, and personalities influenced the ways these teachers experienced and perceived professional development, especially district-sponsored professional development. Therefore, with the research purpose and the goals in mind, I did not want to discount the distinctive differences and uniqueness between each teacher by abandoning their boundaries and joining their transcripts into one intact piece.

Data Coding

As soon as each interview was conducted it was transcribed verbatim and imported into the data coding software (NVivo). In late fall of 2008, the coding and first-pass analysis was completed and I began to write memos describing the emerging themes and patterns. These memos were then correlated, and organized around the research questions and the theoretical framework of the study for further analysis. This process continued until the end of the year (December 2008) and until the findings to the research questions at hand were addressed. After the data coding, memo writing, and data analysis was completed, the complete dissertation writing process began. The writing process took place between January 2009 and summer 2009.

Patton (1990) and Creswell (1994) asserted that there is no one correct method for analyzing qualitative data, but clearly the strategy chosen must reflect the purposes of the study. However, after reviewing literature on qualitative data analysis, I adopted a plan proposed by Shenton (2004), who grounded his suggestions on the initial propositions of Glaser and Strauss (1967), Lincoln and Guba (1985), Patton (1990), and Creswell (1994).

I used a hybrid system of data analysis, which involved a combination of paper and electronic forms of data coding, data chunking, data organizing, and synthesizing. During paper (or hand written) analysis, I used such techniques as color coding, memo writing, scripting, truncating, and note-taking. I also used an electronic form of analysis employing the NVivo software to code, sort out, rearrange, and reorganize data. I used two types of data analysis: *formative* and *summative*.

During the formative data analysis, I utilized a post-transcription review, which took place soon after the creation of all transcripts. This review involved several steps. The first step was *data cleaning*, which is a process of highlighting (or color coding) a text in the printed copies of each transcript to indicate its irrelevance to the research study. For example, the following text from one of the interview transcripts was identified as irrelevant to the research foci of the study and therefore was eliminated (deleted) from further analysis:

> When I was in high school in mathematics, sputnik had just gone up. So they were paying us to take math and science in high school. So a lot of us went to math and science. I graduated from a class of 400. One of our graduates is the CEO of GE. One of ours is the best neurosurgeon in the state of California. He's a teaching neurosurgeon at Stanford. One of our people was the agricultural secretary of South Dakota.

Second, I entered the cleaned transcripts into the NVivo as raw data. I then compiled *insightful quotations* while reading each transcript. These were highlighted in the

electronic copies of each transcript and coded to indicate their strong relevance to the

research study. Below is an example of such text that was highlighted at this stage of the

data analysis:

> Well, the [professional development] that I rated the lowest was 'I'm given time to work with other teachers as part of my professional development,' and I guess I was looking at the whole picture, because I've been teaching for 22 years and I would say that one, overall, is the one I've been given the least amount of opportunity to do, is to work with other teachers.

Next, I began to work on *theme tracking*. Once all transcripts had been entered into

NVivo, I continuously read the highlighted quotes in order to detect recurring patterns. It

was extremely helpful to have the participants' Teacher Surveys as additional documents

to verify, compare, and clarify the teachers' data. For example, the transcripts from the

three special education mathematics teachers revealed that their responses about student

learning of mathematics varied immensely from the rest of the thirty-two participants.

These variations prompted me to go back to the Teacher Survey (teacher background

section) and realize that these three teachers were dealing with different types of students.

In other words, this step of data analysis helped me to identify both frequent responses

and rare responses (outliers) in the data.

The last step in the formative analysis was *identification of links with previous*

work. After identifying some patterns or themes, I printed the highlighted transcripts and

began re-reading them. I then revisited the research questions of the study, theoretical

framework, and the literature findings on professional development and teacher learning.

The data within the transcripts that reminded me of past research was color coded with

several notes concerning the authors and research findings that connected to my data

patterns. This step allowed me to compare my first-pass data analysis results with those of previous projects.

The *summative analysis* also involved several steps; these steps were more focused on organizing, articulating, and formulating the data findings. The first step in this process was to *shift to rule-based definitions* of my categories. After identifying the themes and patterns, correlating them with the research findings and developing more specific categories, I began taking notes (by hand) to be able to write memos for each category as notes for compiling and extracting the "meaning" of each category. Glaser and Strauss (1967) suggest that the writing of memos in this way draws on "the initial freshness of the analyst's theoretical notions".

In the second step, I developed a *data dictionary*. After I wrote the memos, many of them began to mirror specific concepts. For example, I wrote a number of memos related to teachers' professional needs; however, the memo descriptions emerged to reflect larger concepts such as: professional needs related to individual learning, professional needs related to community learning, and professional needs related to policy. These paralleled the teacher learning levels in the theoretical framework of the study. Thus, initially, my descriptions in the data dictionary included numerous memos but, over time, these began to come together and eventually consisted of series of memos (or sections), each of which was either devoted to the research question or particular concept within the theoretical framework of the study.

The last step in my summative data analysis was dedicated to the *creation of possible concept webs*. This step allowed me to examine connections between concepts within my data. For example, after I developed data dictionaries for the aforementioned

concepts of teachers' professional needs within individual learning, and within community and policy learning, it became apparent to me that some teachers occupy all three of these concept categories, some appear in only two, and some belong to only one of these concept categories. I examined these teachers further, looking at their grade levels, curricular materials, education (bachelors versus masters), and years of experience. As a result, I found that the number of years of teaching experience plays an influential role on the complexity of teachers' professional needs. In this step, I used different techniques, depending on the concepts. Sometimes, I drew lines (by hand) between the concepts until they made sense to me and depicted the correct theoretical image (Shenton, 2004). At other times, I used Huberman and Miles' (1994) approach to "cluster" the data by conceptual mapping to be able to link broader and narrower concepts. However, it is requisite to mention that I was not able to link *all* of the concepts (including those I wished to link) that I developed in the process of data analysis.

As the concept webs progressed, I found myself taking a one final step: identifying *implications of my data analysis*, especially considering the overall conclusions and relating the findings of the study to a wider picture. In this step, I jotted down notes about possible recommendations that I should make in terms of research, ascertaining new questions for future projects, and in terms of practice of professional development for teacher educators, school teachers, and district coordinators and administrators. This step was necessary to be able to situate my findings not only within the goals of my study, but also within the research field on mathematics teachers' professional development (see Figure 3.2). Regarding the reliability of the coding

process, please see the following *Trustworthiness* Section of this chapter, under

Confirmability of the research study.

STEP 1: Formative Data Analysis

Data cleaning	Insightful citations	Theme tracking	Links to previous work

STEP 2: Summative Data Analysis

Rule-based definitions	Data dictionary	Concept webs	Implications
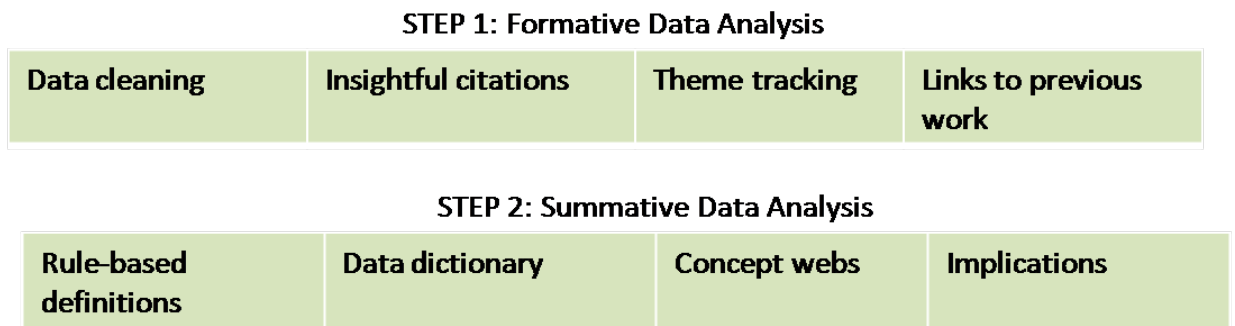
Figure 3.2 Outline of Two-Step Data Analysis Process Used for the Study

Trustworthiness

The trustworthiness of the research study can be addressed in many different ways, using various components and levels. In this section, I address the trustworthiness of the research findings through considering four criteria: credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985, p. 219).

With regard to *credibility*, the soundness of the collected data, I triangulated the data by collecting data from several different sources: Teacher Surveys, Follow-up Interviews, and the interview and survey data from the mathematics district coordinator. Moreover, the Teacher Survey was adapted using the instruments developed by the Horizon Research, Inc (HRI) (http://www.horizon-research.com). These instruments of HRI have been tested at length for both reliability and validity. The Teacher Survey was a successor of the larger database instrument used in a recent study on the Schools Systemic Climate Change published in the *Journal of Research in Mathematics Education* (Heck, Banilower, Weiss, and Rosenberg, 2008) I adapted the HRI instrument

by taking out the questions that were irrelevant to the research focus of this study and by rephrasing the multiple choice questions that were research-specific to be open-ended, allowing me to follow up with the teachers and their responses during the follow-up interviews. The adaptation of the ready-to-use HRI instruments not only saved time, but added a considerable amount of legitimacy and credibility to the data collected. Many of the questions adapted from the HRI Teacher Survey generated thorough, genuine, and sincere responses from teachers.

The HRI instruments have been widely used in research studies of the National Surveys of Science and Mathematics Education. HRI staff includes experts in advanced statistical techniques, as well as qualitative analysis. Horizon Research, Inc. (HRI) has provided policy recommendations and services for various organization such as the National Science Foundation (NSF), the Congressional Office of Technology Assessment, the Carnegie Corporation of New York, and National Science Teachers Association and the National Council of Teachers of Mathematics.

With regard to *dependability*, in other words the construct validity of the collected data, both the Teacher Survey and the follow-up interview protocol were piloted for construct validity with the graduate students at the University of Missouri, who were former secondary or middle school mathematics teachers originating from different states and districts. After the piloting, the participants were asked about the following: a) were the questions of the interview protocol clear? b) Was specific terminology in the Teacher Survey or during the interview confusing? c) After answering these questions, what do you think was the goal of the study? I also took about 20-30 minutes to summarize the

responses of the pilot participants back to them and to ask whether my summary was accurate.

With regard to *confirmability*, which means corroboration and validation of the collected data, the transcription and coding of interview data was also verified for consistency. I listened twice through the audio recordings and verified the transcriptions for accuracy and correctness. Another graduate student, not involved in the project, randomly selected one transcribed excerpt for coding verifications. After comparing the two codes, about 85% consistency was observed. I also selected a random transcript (2-pages) for my dissertation chair to code. After correlating both sets of coding the consistency rate was 95%.

To establish *transferability*, also known as generalizability principle in quantitative studies, I provided as much as possible of the description about the context of the study, giving details on curricular adoption, the size of the district, the detailed characteristics of the teacher-participants of the study, as well as the descriptions of the district, the schools in this district, and other teachers employed in the district. I also provided detailed descriptions about the district climate and the professional development opportunities offered. This "thick" description (Geertz, 1973) should help the reader(s) to better understand the findings, and be able to *transfer* the research conclusions to comparable contexts.

Summary

In this chapter I presented a detailed description of the design of my study related to the purpose, goals, participants, and data involved. In particular I provided an

overview on the research tradition underlying my beliefs and identifying the

methodology and theoretical perspective of the research. I also gave full descriptions of

the data sources and data collection procedures, the context of the study, characteristics

of the participants, and the process of data analysis. At the end of the chapter I also

reflected on the trustworthiness of this study.

In the next chapter I present the result from data analyses, elaborating on patterns

that emerged within the data, and providing specific quotes to support my findings and

results. At the end of each section I also provide specific assertions that underline critical

findings in the study (for that specific section) and offer a short summary of each finding.

CHAPTER 4: RESULTS

In this chapter, I report the findings from data analysis of teacher responses to a series of questions focused on three major themes: *What do teachers want (or feel the need) to learn? How do teachers want to learn or satisfy their needs through professional development? Why do teachers want to learn or participate in professional development?* I separated this chapter into the three major theme sections, each of which includes subsections that reflect major findings within each section (or a theme). Some subsections also include findings reflecting common patterns or noticeable major differences within the teacher responses. For example, in the first section (What do teachers want or feel the need to learn?) one of the major noticeable differences was in the way experienced teachers who were taking on leadership roles (such as coaching, or mentoring) described what they wanted to learn as compared to teachers who were not involved in leadership. These teachers, similar to other experienced teachers, wanted to learn about important aspects related to mathematics teaching and learning. However teacher-leaders had additional learning needs specific to their leadership roles that other experienced teachers did not have. The findings from this section, therefore, were separated into a separate subsection: *additional professional needs of teacher-leaders.* Consequently, the subsections of other sections were structures and organized in a similar fashion.

I remind the reader that twelve (of the thirty five) mathematics teachers in this study were novice teachers (with less than five years of teaching experience), the rest of the teachers were identified as experienced. However, within the text of this chapter, I

also identify the teachers who were department chairs, mentors, and teacher-coaches, and teachers with more than fifteen years of experience (veteran teachers).

Why Did Mathematics Teachers Want to Learn?

In this section I report the findings from teacher responses to a series of questions related to their motivation and reasons for learning, in addition to teachers' responses about specific features of professional development that motivated their learning in the past.

Shulman & Shulman (2004) did not define what teacher motivation for learning entails nor did they describe what might influence teachers' need and desires to learn professionally. In their framework the authors simply stated that, "Every teacher should be willing and motivated to learn professionally" (p. 261). I agree with this statement and accept this statement as true. In fact, when conducting the study, I approached every teacher to examine and learn more about their motivations and reasons for learning, rather than documenting whether or not the teachers were motivated to learn at all. In other words, the findings in this section are targeted specifically towards documenting, *Why do mathematics teachers want to learn professionally?* rather than answering the broader question, *Do teachers want to learn in general?*

As a result of data analysis, teacher responses related to motivation of their professional learning were classified into two subsections: a) reasons and motivations for teacher professional learning, and b) specific features of professional development that motivated teacher learning.

Reasons and Motivations for Teacher Professional Learning

The results of the data analysis indicate that every teacher in this study expressed a desire, need, and a motivation to learn but not for monetary or financial reasons. Very few teachers actually mentioned reimbursements or inservice credit for professional development participation during their interviews. However, the teachers who did mention reimbursements and credits spoke of them parenthetically. For example, Mary Lou, a veteran teacher, mentioned that earlier in her career she at times attended professional development because it helped her move up on a salary scale; however it had not been her primary reason for professional development:

> I want get something out of it. I really want get something out of it. And you know, in the olden days, I needed it to move out on salary schedule. So I would take indentifying dead fish from their scales if I started to move over, but I'm already at the end now, so I don't have any – there's no monetary reward for me. And sometimes they'll pay you to attend, but other than that, I want to get something out of it that I can use. I don't want it to waste my time.

Most of the teachers' reasons for professional learning included being able to better help students to learn mathematics. In fact, the topmost referenced (by teachers) reason and motivation for professional learning was becoming "better" at attending to students learning needs. Second most referenced reason for teacher learning was to increase teachers' own knowledge and professionalism. And finally, teachers indicated that professional learning at times occurred as a result of the district or a school holding them accountable by requiring attendance and participation in professional development. As a result, this subsection is comprised of three major parts: a) teacher learning to improve teaching and student learning, b) teacher learning to improve oneself as a professional, c) teacher learning as a result of accountability.

Teacher learning to improve teaching and student learning

In this study, thirty (out of 32) teachers mentioned wanting to be "better" teachers, or being able to better address students' learning needs, when responding to the questions about motivations or reasons for professional learning. This was true for all teachers regarding of their grade level or years of experience.

A response from one junior high teacher was a representative example of the majority teacher responses, "Because I want to be a better teacher. I don't want my kids – I want to be able to get my kids to learn. I want to be able to provide them with as much knowledge and skills as they need." From this response, it is evident that teachers perceived learning as a channel to student improvement and learning of mathematics. However, teachers described differently the meaning of becoming a "better teacher" depending on their professional needs.

For example, some teachers talked about students' learning specifically describing student *assessment* and being able to accurately evaluate students' knowledge and mathematical misunderstandings. For example, a novice teacher, with less than 5 years of experience talked about "reading" her students' minds:

> Mine goes back to that whole mind reading thing, in a sense, I joke about it, but I struggle with not knowing sometimes which kids are struggling. There are the obvious ones, but sometimes it really seems like a kid gets it and then they take a quiz and they get a 12 out of 30 and you're going wow, ok obviously they didn't understand it as well as I thought they did. So what is it that's leading me to believe they understand it in class? Because obviously they don't. If I could figure out what in the world it is that they're not saying or if what they're saying is telling me something different than what they actually mean (Kelly).

This middle school teacher, throughout the entire interview, continuously mentioned a desire to become a better teacher by learning more about how to "read" her students' minds. She had several examples such as this one, where she struggled to accurately evaluate her students' progress during the teaching; unless a formal assessment was

given. She talked about different strategies she tried using, including working with a mathematics coach in her building, but she felt that at the end of the day there is still at least one child's mind or a face that she failed to "read" correctly.

A high school veteran teacher also talked about student assessment but in a bit of a different format:

> Well, I don't think you can be an effective teacher if you don't know what's going on, if you don't know what the end-of course assessments are, why they're doing them, what they're going to be like. You're shooting in the dark then. So, I just feel like I need to keep informed, keep learning. Everybody has got to keep learning. Some people don't think they do need to (Hank).

Teachers mentioned assessment as a key aspect of teaching that, if strengthened, could help them become more effective in teaching. Consequently, they strongly focused on assessment when describing their motivation to learn professionally. Assessment was not the only aspect mentioned. Instruction and instructional strategies were also identified as another important factor that contributed to teachers' motivation to learn.

Mike, a novice junior high school teacher mentioned that what motivated him to learn was mostly his *instruction*, "I think it's just finding the biggest weakness in my classroom and trying to fix it. You don't know what's wrong until you've tried it. So let's see what happens and then fix it."

Another example was Elizabeth, a middle school veteran teacher and a mathematic coach, who talked about experimenting with her instruction, looking for different ways of teaching, and "letting go" of the control of the classroom during the instruction as a drive for her learning:

> I always think there's got to be another way out there to do it and I'm always looking for another way; a better way. So on the one hand maybe it's a lack of confidence that I'm doing it the best way possible but on the other hand it's confidence that I can go in and work with my kids and say, "Okay, we're going to

do this," and I don't have to know the answers before I go in. There are many teachers that if they don't know exactly the way something's going to play out, they won't take that risk. I go in with, "Hey we're all here to learn," and I do something and it's great and I'll say, "Hey, this was really good wasn't it?" And the kids will go, "Yeah." Or I'll do something and say, "Hey, this was really bad wasn't it?" And they'll go, "Yeah." But I think you have to be a risk taker and you have to realize that there's always something else out there to learn and to do. I know I've taught with people who can't do that unless they know exactly how it's going to play out; they still have to see themselves as in control and havening the knowledge. I guess I'm not always in control, but it's alright for me.

The following quote was another example from Zane, a mathematics teacher, who stated that she was driven to learn because she was aware of the fact that she lacked necessary knowledge to be able to help her students:

> …the kids have helped me to identify where their gaps are in their learning, but then as I go to fill them in, I only know to fill with what I know, and I don't know that my way was the best way. It's certainly not the only way to learn, but it's difficult because I don't even know where to get started, and today we tried to piece together a long division strategy that they were taught and to take children who have gaps and try and develop this strategy is frustrating, and I don't even really know where to go to for that kind of support...

Zane talked about strengthening her knowledge about teaching and instructional methods to be able to help her students with mathematics, especially in remedial courses. Following instruction, teachers were also driven to learn more *mathematics, as a content knowledge*.

Payton, a high school veteran teacher mentioned her teaching and instruction, specifically related to the mathematics she was teaching and provided examples of at times struggling to solve a mathematics problem herself. Payton also mentioned learning how to better accomplish the balance between modeling the mathematics in front of the students and getting them to do mathematics on their own:

> It goes back, 'I know my students will learn better if they're doing the math instead of watching me doing the math.' Yet, I've come across something I can't figure out how to do that so I think surely somebody knows how to do that; so I

go through the steps to see what I can find. A part of it is my desire to figure out how to do that but it's driven by the kids that I'm going to encounter in a few months when school starts up again that I want them doing the work instead of me.

Several teachers also expressed addressing high-achieving students' learning needs and the teacher's knowledge required to be able to do so successfully. Lena, a veteran high school teacher, shared a specific example from her classroom:

> Because I am naturally curious and I love math and I want to bring out that curiosity in my students. I want to be able to help guide them to that. One of the students the other day said, "What if you did this on Rolle's theorem?" I never really thought about it, but I encouraged him to write it up as a proof or whatever, and his idea is right, and I knew the math to say yes, it was right. So, knowing just how to push him a little bit further, even though it's not something that's a part of the course or curriculum. Natural curiosity and comfortable. I want to know the math so I am comfortable answering their questions or guiding them to think of it higher or past where we are at.

Lena, in addition to be naturally curious and wanting to bring that curiosity in her students about mathematics, also mentioned her own desire to "want to know the math" so she can be more comfortable answering students' questions.

Addressing *students' motivation and learning needs* was another aspect of teaching that teachers identified as stimulus to their professional learning. Alexis, junior high school veteran teacher, shared that even after 25 years of teaching experience - she still struggled to reach *all* of her students learning needs:

> Oh there are some days where it goes very well, but I know it's not perfect. I know there's always a kid in the corner who has no idea what's going on. And they maybe sitting quietly and smiling at me when I look at them, and when you get their pencils out at all the appropriate times, but – and those kids - that's hard, because you're just sitting there thinking everything's going so perfect today, and it's just that they're not causing trouble. But I mean it never fails. You'll give a test that you think we went over this yesterday and everybody understood it and now we're all paying attention, and it was so great, and then you got these kids who write things off the wall, and you think how could they have been in the class

yesterday, how could they have missed out on this, and yet they did! And who's fault is that? Well, I kind of sometimes feel like it's mine.

Alexis mentioned that she sometimes blamed herself for students' low performance. She mentioned that even after twenty five years of teaching, she was still driven to learn how to teach and better meet her students' learning needs.

Similarly, Mandy, a novice teacher of four years of experience, also expressed similar motivation for learning. She tried many different strategies to reach perfection in her own classroom, yet again reaching *all* of her students learning needs has been troubling her and inspiring her to want to learn more and become better at teaching and reaching more students:

> Because I never feel like I have reached the perfection that I want to be at in teaching. Every year you've tried things, you've done things and it's worked with a lot of kids and then the next year comes up and there's those one or two kids that you're not reaching. So you want to learn more so that you can reach those kids because I'd hate to leave any kid behind. And I always said that if I get to the point where I feel like I've learned it all, that's the time where I'll walk out the door.

Jane, another novice teacher (first year) also brought up the desire to learn about reaching more students. She was struggling with student engagement issues in her Algebra class that includes students with a wide range in their mathematical knowledge and background:

> Because I think it's really important if I want to be a successful teacher and I want them to be good learners, then I need to have them engaged, 100% of them engaged, all my students, not just half, or 75%. I don't want to see anyone just not there copying down the answers, sitting there. And I wanted to know if they really got the concepts, what are they thinking? So, it's hard. And I'm struggling with differentiation because I keep getting students - I just got this student yesterday- so it's hard. It's getting harder because I have students dropping out, getting new students, coming from geometry, coming from integrated, they're all coming to algebra 1. I need to learn how to really meet their needs

Every teacher, when talking about motivation to learn, remarked their desire to become better teachers regardless of their experience, including the ones chosen by the district as exemplary teachers to provide one-on-one instructional support, coaching, and leadership. Many referenced specific issues they observe from their own classrooms they feel they need to improve, especially the aspects of teaching related to: student learning and motivation, curriculum, instruction, different approaches and visions about teaching, mathematics as a content knowledge, classroom management, technology, and assessment. The teachers explained that the reason why they wanted to gain more content and pedagogical knowledge was to help students become better at mathematics and at learning mathematics.

Teacher learning for career advancement and promotion

In addition to being motivated to learn as a result of teaching and working with students and their learning needs, teachers specifically mentioned their desires to learn to improve their own understanding, knowledge, skills, and professionalism. Some of their reasons were related to teaching; other reasons however were related to their degrees, certifications, and professional careers.

For example, Kim, a junior high school teacher, with over twenty years of experience, also mentioned a desire to increase her pedagogical knowledge, which she referred to a "bank" with instructional methods that she could pull from whenever necessary to support her students' learning:

> I don't want to have questions. I want to be able to know what to do, or to have ideas that I can try. I don't want to be left thinking at the end of the day, what could I have done, what should I have done? It would be nice to have a bank that I can pull from for any questions that I would have.

A few veteran teachers, even after more than twenty five years of teaching experience, also suggested that they wanted to learn more about teaching mathematics, and they wanted to do so not only to improve their students' knowledge but also to improve their own knowledge as well. For example, Elizabeth mentioned that she wanted to become "better" at teaching and that there was more room for her to grow professionally:

I: Why do you want to learn these things?
P: To be a better teacher, my gosh.
I: Aren't you already a better teacher?
P: I'm better than I used to be, but I still have room to grow.

A few other teachers also mentioned wanting to gain knowledge for their own development and fulfillment and mentioned continual learning as a result of their career advancements, indicating working on additional degrees, certifications, taking courses, reading books and articles, and participating in various professional development opportunities outside of the district. These include veteran teachers as well. For example, Pansy stated that she was excited about continuing the learning process after her retirement, by taking additional classes and pursuing areas of interests she did not have time to learn while working:

I: There is so much out there, some people say 'I don't want to learn them because I don't have them in my classroom'.
P: Oh, but I do. I'm closer to retirement than a lot of the teachers that you talk to. The one thing I'd like to do when I retire is go back to university and just take classes on things I'm interested in. Not things that necessarily impact my teaching or math, just things I'm interested in. I've always wanted to learn how to speak Hebrew. I don't know why, but I'd just like to be able to read some of those documents in their original. That's just something I'm interested in. I don't know, just interesting things. I love the writing. I would love to go back and take creative writing classes and not worry that I'm getting a C, just do it because I think it's fun.

Another example was Mary Lou, a veteran teacher and a mathematics coach, who taught middle school for over twenty five years, shared with me that her drive for learning came

not only from seeing her students succeed, but also from her own satisfaction from

learning:

> What drives me to learn? I don't know if there's competitiveness in me that I always want to be able to do things. I remember when I did my national boards and somebody in Columbia had done it and I thought, "Well heck, if they can do it I can do it," and so I did. I just think it's so much fun to just try different things. I love doing different things. I don't want to do the same thing all the time; I want to do it differently and I love being able to touch kids that nobody's ever gotten to. I love for them to say, "Gosh, I never did this well and now I can do it." That's just a real high for me. So, I guess it's just always thinking that there's something else out there that I need to be a part of; I just love it. There's professional development that's applicable to me and to my school and to my kids and I want to be a part of it.

Mary Lou' response indicated that she was eager to learn, yearning and seeking learning

opportunities all throughout her life. She shared that her drive for professional learning is

typically motivated by her desire to learn, but most importantly, by her courage to take

risks while learning, her competitive nature, and beliefs and confidence that she can

improve and reach more students if she increased her professional knowledge.

Similarly, Ava, a novice teacher, who has been teaching high school for a couple

of years, also mentioned learning about practice and teaching strategies to improve

herself as a teacher:

> I don't think anybody can really keep up with the teaching profession and know what's going on, and help their kids, if they take the idea that when they come into school, they know whatever they need to know and they never have to do professional development. I know there's people that do that. It's the same way, year after year, they teach the same style, the traditional style, they've done it forever, and they don't sign up for any of that stuff. They go to the things they're forced to go to, so to speak, but they don't go to the things or volunteer for the things that might help their teaching because this is the way it is. Well, there's always new things going on that you can always gain something from somebody else. Always, even if it's a strategy that somebody has tried in their classroom, and it works, and you've got a chance to share it and you're like, "Oh, wow, I'd like to try that." If you hadn't had gone somewhere and met with them, you would have never known that. You never would have had the opportunity to try

something new, and I think you always kind of have to look for new stuff, or a variety of stuff.

Ava mentioned taking risks while learning and trying new ideas in her own classroom. She also explained that teachers are always exposed to learning opportunities about new and different ideas; however some take these opportunities with fervor and passion, and others take such opportunities for granted. She mentioned that even a quick conversation with a colleague is fruitful if teachers are exchanging ideas and instructional details, and could be easily turned into a valuable learning possibility.

Ava also talked about being driven to learn by her definition of the teaching profession. She believed that the existent enormous various learning opportunities and a large domain of knowledge must be discovered by a teacher if he or she is intended to be successful in the teaching profession.

Similarly, several teachers talked about learning on their own, outside of their classrooms, by attending evening workshops or taking courses at a nearby university. For example, Celeste, a middle school teacher, who had been working on her master's degree while working full time as a teacher, shared that she has been finding the time to take university courses in addition to assisting a department chair, and designing and facilitating a few professional developments of her own:

> What drives me? I want to know everything about everything. I don't ever want to be the kind of teacher or educator who's just spinning the wheels. I just think there's an endless amount of knowledge out there that I still don't know and I want to be in the know. I want to be the best I can be every day, for my students and for whatever I do, and if I don't continue to learn I'm not going to be.

Celeste mentioned about her drive and desire to learn for her own development and enjoyment. She believed that there is a large domain of knowledge that is available for her to learn, and she was thrilled to learn as much as she could because it gave her joy

and she believed made her better at teaching and helping her students learn mathematics. These responses indicate that teachers are not only motivated to learn to become better at teaching, but also are motivated to learn to become more knowledgeable and professional in regard to their careers.

Teacher learning as a result of district requirement and accountability

Nonetheless, many teachers also talked about the need and encouragement to push them to continue to learn and continue to seek learning opportunities by setting accountability requirements. In addition to indicating being eager teacher-learners and helping their students with learning, many teachers mentioned accountability as a secondary (but necessary) motivator for teacher learning.

Amber, a veteran high school teacher (also a department chair) was recalling her experiences with lesson study professional development she took part several years ago, and explained that lesson study was one of her most favorite professional development, during which accountability was part of the learning process, "I loved it, I think because of the support that was there, the accountability, and the process of being able to revise".

However, Grace another teacher explained that unless teachers were hold accountable for their learning, they could easily use the same teaching methods and practice those methods their entire teaching careers:

> Like I said, there's no accountability. There's no one looking to see how you are changing; there's no over-time. How are you improving yourself? No one looks at that. So, I could do the same thing every day for the next thirty years but no one really is going to know besides my kids. There's no accountability folding over us to make those improvements. The only thing that they do is say "you have to get so many hours in."

Grace explained that professional development that simply required teachers to meet certain quantitative requirements for inservice hours (or credits) was not effective for her.

However, instead, classroom observations or teacher collaborations have been better channels for improving her teaching and offering professional growth.

I asked several other teachers about classroom observations. I also asked about a possibility for a teacher to never improve his or her teaching and simply practice the same instruction for an entire career. The majority of teachers actually agreed that that was indeed possible. In fact, they mentioned that they knew a few teachers who have been doing so, and unless the district is going to change its policy and hold the teachers accountable for implementing the learnt ideas into their classrooms, these occurrences will continue happening. Denny responded:

> No one really follows up on how you use what you learned. Like I was saying, I've only had Kim [department chair] in my classroom twice and I don't recall filling out any surveys like 'Did you try this? How did it work?' I don't think I've ever done that, I'd probably remember if I did. And actually, I'm trying to think, things that we learned in professional development were either things that they already told us when I was taking classes at the University, or they weren't helpful and I didn't use them.

Since the teachers indicated that the district didn't hold teachers strictly accountable for professional learning and implementing learnt ideas into their classrooms, I asked teachers about reasons for which any teacher would be motivated to continue to learn. I also asked whether accountability and holding teachers liable for professional learning was necessary to maintain teacher motivation to learn. Many teachers, including the high-attendants of district-sponsored professional development, agreed and suggested that certain level of obligation and accountability is unquestionably needed (and healthy) to encourage and compel teachers to learn and stay active in learning.

Lena, a high school veteran teacher (high-attendant of district-sponsored professional development) explained that in her professional development experiences

the level of accountability played a helpful role of guilt-tripping her into learning,

especially on the days when she was tired and less motivated. She stated feeling culpable

for not completing the assignment:

> Somebody's telling me, "I have to do this, or I have a homework assignment
> that's due in two weeks where I have to have done this, this and this." And I'm
> being held accountable for that and over the course of the time I'm supposed to
> follow up on this. And if I don't I'm going to be sitting with a group of people
> and I'm going to feel badly that I haven't done what I was supposed to do. So I do
> think that's a piece of it, it keeps me going with it. Questioning is one of those
> things too - the level of questions we ask, the way you ask it, the wait time, how
> you call on somebody to respond versus letting everyone blurt it out.

Similarly, another experienced teacher, Holly, also stated that she believed accountability

was an important part of teacher learning. Holly explained that being held responsible

pushed her not to be lazy or fall behind on learning, and persuaded her to continue to

engage in learning:

> This is an example of every year I start off and I'm going to do a better job with
> that this year. Every year I just think 'I need to do a better job with that', and then
> I get lazy and I'm pretty good for a month or two and then I get lazy with it. So I
> think if I had some sort of accountability that was really pressing me to continue
> to think about it and talk about it and read about it I would be apt to stick with it.
> Because I do think that it's important, I know it's important but for some reason it
> fades away.

I spoke to novice teachers about accountability as well, and whether they believed it was

important and necessary. I also asked them about district's requirements and tasks that

they completed or were held accountable for completing. Susann, a novice teacher

described a continual professional development she took part in to meet the school and

district requirements:

> Yeah, you either have something you're given because your principal thinks you
> need to work on something, a professional growth plan kind of thing, or you can
> have a P.E.P which is a professional enrichment plan and that's basically part of
> your staff development, it's things that you individually say this is something I want
> to work on for my curriculum, or for my area, or for my teaching to improve my

teaching. So that gets your hours in, because we're all meeting once a month for an hour, hour and a half, and then we're also making and presentation and working together on stuff. Well, and some people are on career ladder and they'll have that, but they set their own stuff for career ladder.

These responses indicate that teachers, even though maybe eager to learn, need somewhat of a "push" and encouragement to continue learning and stay active in learning. Teachers mentioned that simply requiring certain number of professional development hours or credit was neither effective nor motivating. However, instead, teachers indicated that encouraging teachers to try and implement new ideas in their classrooms, or insist on teachers to utilize the knowledge and skills gained from professional developments, or hold teachers accountable to create their professional development plan addressing their needs would be more valuable, effective, and encouraging to participate in learning. Teachers also shared that such accountability model may perhaps yield better teacher learning outcomes - more qualitative – rather than accumulating hours, credits, and points for attending professional development.

Specific Features of Professional Development that Motivated Teacher Learning

In regard to specific features of professional development, the teachers mentioned different aspects and features that they found effective and motivating for their learning. Some described a specific topic or a content of professional development; others were particularly specific about the contexts of the professional development, and many teachers also focused on specific processes and methods (or models) of professional development they found effective and encouraging for their learning. Teachers also mentioned additional features of professional development that were difficult to classify into a content-, process-, or context-specific category. As a result, the findings in this section were separated into four parts: a) content-specific features of effective

125

professional development, b) process-specific features of effective professional development, c) context-specific features of effective professional development, and d) additional features of effective professional development.

Content-specific features of effective professional development. Teachers made specific suggestions about what should be the core and the focus of effective professional development, especially regarding the content of the professional development. Many of them suggested that the content of the professional development needs to be focused on different aspects related to the teaching of mathematics. Many teachers' responses were similar in a way they described the applicability of the learnt material to their classrooms; however the novice teachers were specifically concerned with directions and instructions that the professional developers must include when sharing ideas and offering recommendations.

Many teachers said they found effective the professional development that provided activities for them to take back to their classrooms.

> I need to be able to find some value of something that I can take back and use in my room. I've gotten into some things where the title of the book sounds like it's going to be really awesome and it's not it at all! Or it's not what I thought it was going to be. So it needs to be something that I feel like I can impact what I'm doing at some point in time in this year. Even if it's just an activity that I think is really cool and I'm going to use it in February; doesn't necessarily have to impact what I'm doing every single day. If I can walk away with one thing for February, then I think that's helpful (Amber).

Amber is an experienced teacher, who placed a strong emphasis on immediate applicability of the content of the professional development to her current teaching and classroom practices.

> I feel like the best ones I always walk away with something that I immediately either can apply, or I know I'm going to remember what I'm going to. Like I'm almost in the middle of the session, and I think, 'Oh I know this is going to work

in chapter 3 when I do such and such, I'm going to be able to use this'. Or even if it's not just a skill or activity, it's a way to be thinking about things differently.

This teacher spoke directly about reflecting back to her classroom. In her mind, effective professional development provides ideas and thoughts that push her to contemplate about teaching, classroom events, and her knowledge.

Several teachers also pointed out that they rated highly the types of professional development that were focused on the curricular materials and the mathematics content, especially if it was directly related to the curriculum and the mathematics they were currently teaching:

> The best ones were usually district-wide. They were mathematics centered or mathematics education centered. They were centered around the curriculum that I teach. They were very focused, the person who developed it. This was the purpose, and I saw it as a good purpose. And we were able to create something that helped me be a better teacher and or helped my students do better at mathematics in my classroom (Aaron).

For Aaron, a novice teacher, the best professional development was specifically related to his classroom teaching and focused on the mathematics and the curriculum he was using. Colin, a veteran teacher on the other hand was looking for a specific session on student learning and motivation that was in a close proximity to his school town:

> I looked around for a professional development or workshop, … not too far away, somewhere we could drive to. There was one in Westville on motivating students. It was a two-day workshop and I got permission for the two of us to go and attend that. It was very helpful. The suggestions that were made were on target a lot. I don't agree with everything that was said, but I know that the person believed in what they were saying and how they were saying it.

Colin mentioned the speaker and that the speaker was genuine about the information he was presenting. He also did not put much emphasis on the need for the recommendations to have immediate applicability to his classroom. Another veteran teacher also mentioned that in the past she attended professional development not for the content or the activities

per se, but simply because she knew the speaker was a motivated, respectable, and experienced educator. She mentioned that to her effective professional development included motivating teachers to love and feel good about their jobs and increase teachers' desires for teaching, learning, and working with students:

> I've gone to a lot of, when I was working in Michigan, I went to a lot of Michigan conferences where it was all Michigan teachers, and I actually had the opportunity to go to some of the regional conferences of the National Council of Teachers of Mathematics. It always seemed that there was a nice choice. If you were interested in one specific topic, you could go and listen to ideas on one specific topic. If you were looking for a broad range, you could go to those kinds of workshops. If you were interested in an activity-based thing, you could do that. It always seemed that you could pick things that you wanted. Sometimes I would go to a talk just because it was something I didn't know anything about, or it was something that I didn't teach, but I just want to sort of see how somebody else did it (Kim).

Kim mentioned that to her it was important to have a variety of topics to choose from that were related to the teaching of mathematics, however to Kim immediate applicability to her classroom was not as important as it was to many other teachers (e.g., Aaron and Amber).

Several central factors emerged from teachers' responses to the questions about professional development and teachers' perceptions about characteristics of effective professional development. Number one factor voiced by the majority (28 out of 32) of teachers was the ability to learn new instructional ideas that was applicable and relevant to their classrooms. Teachers talked about "good" professional development offering opportunities for them to learn new methods of teaching mathematics, innovative instructional strategies, specific tools, technology, and concrete mathematics activities to be able to help students' better understand, learn, and enjoy mathematics. However, most of the responses were centered on eight central factors of pedagogical content knowledge

that teachers mentioned earlier as their professional needs for learning: curriculum, vision, mathematics content, student learning, technology, assessment, instructional strategies, classroom management. Some teachers were specific in regards to what exactly they were looking for specifically when seeking learning opportunities:

> Most of the time I'll look for math, then I'll look for technology and then usually I'm looking for some sort of student learning. How can we address the needs of giving students ample opportunities in class and giving it to them in different ways so they can learn? I think that math, technology, and student learning; those are the top three things I would look for (Pat)

Pat spoke about professional development being content-specific (in this case mathematics), include innovations such as technology, and be focused on "giving students ample opportunities" and various ways to approach and learn mathematics. Indeed, professional development that focused on student thinking and learning of mathematics was highly rated by the majority (27 out of 32) teachers.

However, some teachers also talked about the content of the professional development as it impacted their learning. For example, Michaela specifically mentioned the content of the professional development to create a "cognitive dissonance" moment for her, impelling to ponder and question her own classroom practices:

> I was able to learn a new method, either technology, or teaching method, or approach. That is probably mainly in the AP conferences. Or when we did the curricula - the grant work professional development. I also said I like it when whatever they are presenting causes me cognitive conflict and causes me to question what I am doing and reflect on what I am doing and if it is right, wrong, or could be better or improved. And that would be more towards the grant. We would always bring in topics of 'Yes, you are doing it that way, but what is best for the students? Are the students active when you're doing that?'

Beside the cognitive dissonance moment, Michaela too indicated that learning a new instructional method or a teaching approach was valuable at all times. Learning "new"

ideas and acquiring new information related to teaching was mentioned by many teachers in the study.

> The best ones were when I was presented with things that I didn't know. When it wasn't just repeated stuff that – and I don't know might be new to somebody, but sometimes you'll lose me in the beginning if you're just giving me stuff I already know. They've been when I go and have to do something (Chelsea, novice teacher).

In addition to these features, several teachers also suggested that research-based information and recommendations should be included in the professional development content because it was helpful and useful for their teacher learning:

> I also like research but only when research is presented in a way that can be applied to my teaching. I don't like research say just for research, like, 'Research shows we should do this'. That doesn't mean anything to me unless you take it to the next step and say how can we implement this in a classroom, or how is it already being implemented, I guess is better, because sometimes when they say, 'How can you do this now?' Its like, 'I'm already doing fifteen things now'. But a lot of times what they're saying is it's something new, but if they present it as a way as: 'How are you using this now in your classroom? Could you make it more effective?' As opposed to 'Here's a brand new concept of this new research that we should be doing now. How are you going to put it into your classroom?' I mean come on! I mean unless it comes with a guarantee that it will change everything, I don't really want to know. (Mindy)

Mindy talked about two types of professional development: the ones where she learned new ideas and the ones that helped improving and advancing her current practices and instructional strategies. Nonetheless, she clearly put greater importance on the professional development that was related to the practices she was already using in her classroom rather than introducing new strategies for her to try. She stated, that she preferred for the professional development to approach ideas with questions such as, "How are you using this now in your classroom? Could you make it more effective?" in contrast to the professional developers introducing new ideas and leaving the implementation of those ideas to the teacher to figure out and work into the classroom.

Mindy specifically mentioned that she would still not favor such approach - even if the ideas were research-based, effective, and resourceful unless "it comes with a guarantee" she was not interested to learn about them.

Teachers pointed out that, for professional development to be effective, its applicability and relevance to teacher classrooms and mathematics teaching was necessary. However, unlike experienced teachers, the novice teachers stated that they needed specific instructions and guidelines for implementation of those ideas into their classrooms, otherwise the professional learning and applicability of what is learned to their classrooms was not effective for novice teachers.

For example, Sidney, a novice teacher, also indicated that she believed effective professional development should draw upon strategies and ideas that were particularly useful to her classroom, or were related to the practices she was practicing in her classroom. She valued those types of professional development because it helped her improve her teaching by offering new ideas to try out, explaining certain phenomena happening in her classroom, and ground those ideas and explanations based on her existing classroom practices:

> Again, I just go back to it was meaningful. It was something that I was able to sit back and it reinforced something that I was already doing. I could go back and say, 'Oh, I already knew that with my kids!' Or it was something that I was able to say, 'Oh that makes sense now. Okay, this is why this kid didn't understand this', or 'This is something that I can take back to my classroom and start using it tomorrow'.

Once again, Sidney stated that it was important for the ideas and suggestions to be explicitly and be directly applicable to her classroom population, environment, and practices. In contrast however, experienced teachers were more flexible with the suggestions. For example, some of the experienced teachers spoke about valuing the fact

that they can use the materials and activities in the long-run and for long-term, instead of simply covering one topic or being used for a single lesson. For example, Lena specifically suggested that the content of the professional development should be focused on long term goals of mathematics teaching, attending to both the breadth and depth of mathematics teaching and learning. She mentioned connections of professional development activities and materials to other mathematics topics and lessons as well, to be able to get students to see the greater applicability to mathematics:

> I think about every time I go to a regional or national conference, you go and you think you're going to and get really good ideas, and something sounds really good on paper, and you go and it's just a sit and get. There doesn't seem to be the applicability to my classroom that I would have liked to have had. Or it's a cute little activity to do here or here, but it's not something for the long haul. And that's really what you're looking for, something that's going to help the kids throughout the year, not just for this one little topic or this one little event (Lena)

As a result, teachers specifically mentioned the content of professional development to focus on teacher opportunities to learn new and innovative ideas (e.g., activities, or tools, or instructional strategies) that they can take back and apply to their classrooms. Teachers especially valued learning opportunities that focused on student learning and thinking about mathematics and various ways that teachers can use to help students increase their understanding and performance in mathematics. However, the novice teachers suggested that effective professional development need to include more specific and explicit instructions (or directions) on how to implement the proposed ideas and that effective professional development should build upon teaching practices the novice teachers already using in their classrooms, rather than present new ideas to try or to test and implement.

Unlike experienced teachers, the novice teachers, however, indicated they would like to be able to immediately apply or use the professional development recommendations in their classrooms, thus they suggested the recommendations to mirror their classroom environment, population, and instructional practices. The experienced teachers, in contrast, were more willing to figure out ways to work the professional development recommendations into their classrooms and did not urge to focus the content of professional development to be directly and immediately applicable to their classrooms, as long as the content was targeted to improve and advance student learning of mathematics. Unlike novice teachers, the experienced teachers also mentioned valuing ideas that were lasting and versatile, and that they would like to see more of the recommendations that are long-term rather than immediate or temporary quick-fix.

Process-specific features of effective professional development. In addition to describing the content of professional development, the teachers also provided specific descriptions of the specific processes they found effective and enjoyed as learning opportunities. The topmost learning process mentioned by teachers included opportunities to work with other teachers, share ideas, and brainstorm about mathematics teaching and instructional practices. For example, Ebony, a novice teacher indicated that effective professional development for her meant offering opportunities to share and discuss pedagogical ideas with her colleagues, particularly mathematics teachers from her school and her department. She also mentioned that she valued research-based ideas, especially the ones that were tested and demonstrated significant positive outcomes in student performance:

> Just something where everybody's encouraged to bring something to the table, and we get a chance to actually discuss each other's ideas and see where that

takes us. I mentioned that it'd be nice for some of those ideas to be research-based because we were real big on that during Fellows when I was working on my master's and everything. Having that research to back that up. But at the same time, I don't want to sit through a book report or a summary of an article or something. I like knowing where these ideas are coming from without having to hatch through all of the research that is attached with all of that. Just everybody brings their ideas to the table, handouts are always good. I write really slow, so it's kind of a pain to have to take notes while they're talking about all that stuff. It'd be nice to be able to do all this stuff with the people I work with.

Nadia, an experienced teacher, situated her learning process in a more specific setting (than Ebony). She indicated that teacher conversations that are content-specific, especially related to the curriculum and courses the teachers commonly taught were valuable and constructive to her learning. Nadia suggested that teacher collaboration must occur on a regular basis so that those conversations stay the "forefront" of teachers' mind:

> So then we talk about the interdisciplinary part and then we come back and we get down to, "Okay, how do I do this in Algebra 2; how do I make that work for me in my class and I've got somebody else to talk to about it that's in the same place?" And we're talking about it every week so it stays very much at the forefront of your mind. So much professional development stuff and even I can read a book and I can get so inspired or so excited about something but still many of those things don't stick with me forever.

Similarly, Amber, an experienced teacher and a department chair, also mentioned content- and curriculum-centered professional development, where teachers have opportunities to discuss and develop curricular issues related to teaching mathematics. Amber, indicated that having conversations with other mathematics teachers about teaching Algebra would be the most beneficial and effective professional development for her, especially if she was teaching Algebra:

> And probably the important piece of it is to have the chance to talk to somebody else who's in the same spot I'm in, in terms of the curriculum. And I started off to say the best thing for me would be to be able to talk to Vicky [another teacher in the building] because we're teaching Algebra 2 out of the same book and we've

got a 95 minute block schedule; that would be my best conversation. I could also talk to somebody whose teaching Algebra 2 with the traditional schedule out of a different book and probably have a similar benefit. But to put me, as an Algebra 2 teacher, with a Geometry teacher or Calculus teacher then I'm starting to lose a whole lot of where I get the most benefit from.

In regards to learning technology, many teachers suggested to have the tool in front of them and to have hands-on experience learning the tool. Hank, experienced teacher, talked about learning a great deal about online applets and software because he was "hand taught" to him. He also indicated enjoying learning through working in groups and solving challenging mathematical problems:

> One that I can recall that I did enjoy was in a computer lab because we got to be hand taught - it was a technology that I've forgotten the name of and obviously I don't use it anymore as a result. But it gave me some different ideas for websites, and I just started looking on my own finding things like that. The ones I like are not lectures - I like the idea of working in small groups solving problems. As far as math, I would like to work a set of challenging problems and learn different teachers' perspectives on how they would solve it, and then how would you present, how would you expect students to solve a problem. So how do you solve it, how does another teacher solve it, and what would you expect the students to do to solve it?

Evelyn, an experienced teacher, also shared positive experience with professional development, especially because she is learning new ideas about assessment. Evelyn stated that perhaps immediate application of the professional development recommendations is not always possible; however, even if she learned one new idea it is worth the time and effort:

> We're doing a lot of this assessment for learning. Really starting to talk about objectives: 'What are we trying to teach students? What are the students going to demonstrate to show that they learned?' And if I go away from something good like that, it may not be a matter of, 'Oh I'm going to do this in my class tomorrow', but it's going to change the way that I ask my questions in class the next day, or it's going to make me anxious to go back to students' test and really analyze what they did wrong on that question that I just took two points off and stop and think about what it meant to them, and how I was going to help them learn what they missed. So anything that makes me think that I can really go use

it, I feel like that makes it effective. And more the better. And sometimes you'll spend an hour in a conference and you pull away one thing and it's worth it.

As a result, many teachers rated the most effective professional development learning process –community learning. Teachers suggested that effective professional development should be situated within a community of teachers and not be in a form of lectures. Instead, teachers suggested, professional development should involve solving mathematical or pedagogical dilemmas, discussing and examining students' work, and learning about innovative strategies, ideas, and resources for them to explore and use in their classrooms. These responses also indicated that the community of learners must have common content-specific and curricular-specific goals and interests.

Teachers also shared a few negative experiences, as examples of ineffective professional development they experienced and what can be done to improve those experiences. Teachers mentioned unmotivated and insincere speakers or facilitators of professional development, especially in the formats of lectures, workshops, and presentation sessions. Teachers clarified that at times the speakers were not eloquent, and, most of all, they were not genuine, credible, or realistic in their recommendations. Some teachers also criticized that often the presentations were too drawn out, recycling and repeating the same information, or too general without any specific conceivable or practicable detail applicable to their classrooms. For example, Lindsey expressed frustration with some of the conference sessions she attended where the time was not enough for the teachers to delve deeper into the topic or task at hand. She recommended that effective professional development should be extended over a longer period of time, and in case of a workshop, it needed to be longer than a typical 50-60 minute session:

You know, I've done some stuff at NCTM or sitting in on a session, do you consider that professional development? But I could say - those were so awful. Sometimes I'd get up and leave. I've gotten to the point where I think, 'This isn't worth my time, I'm not going to pretend it is and stay,' so I get up and leave. I think some of the things that make it so worthless is, 'You were just there for fifty minutes so you didn't have the opportunity to dig deeply into anything, you're just scratching the surface'. So I think effective professional development has to be something where you've really got some time. Those extended three hour sessions have always been far more beneficial to me than the one hour sessions.

However, lengthy professional development sessions were not favorable by all teachers, especially depending on its goals, nature, and structure. For example, Carrie, novice teacher, actually spoke negatively about attending 3-hour long Power-Point presentation. She especially disliked the fact that the speaker read his entire presentation from the computer screen. Carrie also mentioned not finding the session particularly useful because she could not provided with specific implementation guidelines to apply speaker's recommendations to her classroom:

Last year, all the first year teachers had to go to this professional development that focused on positive behavior support, which is this discipline program that the district is trying to implement. I think the purpose of the seminar was to introduce us to the ideas, and then also share ways that we could use the ideas on our own classroom. It was a 3-hour long power-point presentation. It was horribly boring. I think they had some discussion questions thrown in there somewhere, but we spent very little time on them, and it was just so - I couldn't see immediately how to use it in my own classroom. This is something they're trying to implement district-wide. It's nice to see, and maybe spending half an hour on it would be ok, but 3 hours, no! I really think that there's such a thing as classroom narcolepsy where the attention span only lasts so long. If you've got somebody that's just talking away, reading off power point slides for that long of a time, oh it just drains the life out of you. I mean, it was all the information they gave us could have been summarized maybe in 2 pages, taken half an hour to go through and be done with it. It wasn't something that I could use immediately, especially since it was before I even started my first year, so I didn't really have enough classroom experience to know how I would be using this kind of stuff. So if I can't see the immediate use for it, then it's hard for me to really devote a lot of my attention to it. It was: here's what it is, here's the definition of it, here's the theory behind it. Theory's great and all, but I can't use theory. I need something practical, like, 'So how does this actually work?' A lot of people can't always answer that question.

Many teachers expressed frustration with the quality of speaker-presentations, especially

in regards to losing interest and becoming unmotivated to pay attention and learn the

information presented to them. Another example was Audrey, an experienced teacher,

who spoke critically about some of the speaker-presentations she attended as part of the

professional development. Audrey was identified (by the district) as a high-attendant of

professional development opportunities; however, she stated that her experiences with

several of these professional developments were quite dismal. Furthermore, like many

other teachers, she too was quite annoyed with the Power Point presentations, especially

the ones where the information was read to her the entire session:

> Worse ones have been when people would do PowerPoint's or give me packets
> and read them out loud to me. Why make a PowerPoint if you're going to just
> read it? Especially when they give you the handout of the PowerPoint – I read
> through that in the first 10 minutes, and the rest of the time I just sit. Unless each
> slide you're presenting something that's not on there, but those are the bad ones.
> Then to sum that, the presenter seems like they're more in a hurry to get out of
> there than I am, they're like, 'The quicker we can do this' and so you kind of sit
> like, 'I'm really motivated. I was ready to spend an hour and a half here, and now
> you're telling me we can get this done in 45? Well, just give me the papers then.'
> Like if you're going to present and spend my time, then you need to go beyond
> what's in the information you handed me. I think I've gone to some I think the
> grade information was in that packed, but I can read. I can read, don't spend the
> whole hour telling me about it, because I'm just going to take this packed and
> throw it away, because you modified it and given it to me. Make me think about
> it, and force me to want to go look at that packed, because I want to learn more.
> Also, I don't like a lot of discussion without a closure to it. Like, 'Here's just a lot
> of things to think about that are bad with the content, the curriculum - things that
> are problematic', and then leave them at that. I don't want to go to those things
> that make a lot of questions that don't have any answers. Because I'm more
> quickly to dismiss that, so rather than questions – 'Here are some solutions, here
> are some answers, here are some things to try'. You've brought to my forefront
> 'these are problems', and you've given me some options or made me think of
> some of the options, and now I want to try one.

Another experienced teacher, Bailey also shared her negative experience with

presentations, which she referred to as "aggravating":

Another thing is, some of these bad ones are the ones where I was not challenged mathematically, there was no time to talk to other teachers, and I did not learn anything. I remember in quite a few times that the presenters will never have any time for teachers to talk and that is sometimes when you learn the best, where you exchange email addresses, get some project ideas. That's aggravating. If I would do a workshop - that would be high priority - just the collaboration time.

Bailey, once again confirmed other teachers' responses in regards to effective professional development including challenging tasks (both mathematical and pedagogical) and opportunities to work and exchange ideas with other mathematics teachers.

From these excerpts it was evident that several formats of professional development, such as lectures and presentations, were not effective for teachers because of the mismatched (too long) time length was allocated to them, teachers were inactive listeners, and the presenter passively read the information from the projection screen. In Audrey's case, she complained that her effort and finances spent on a ninety minute professional development session were consumed and wasted because the facilitator made a decision to cut half of the allocated professional development time. Furthermore, teachers also expressed disappointment that many worthwhile questions, raised and presented during the session, that were typically left undefined and unanswered, offering no response or solutions to the teachers.

Another pattern in teacher responses related to professional development in a format of a session or a presentation, in regard to the activities that the presenters used. The teachers suggested that mathematics-specific activities that were challenging and insightful in terms of pedagogical relevance and applicability were found to be the most effective and useful. However, many other activities used during these sessions were not. For example, Olivia (experienced teacher) talked about not finding much of the

professional development effective, especially some of the activities that tended to be

irrelevant and of very little use to her classroom teaching:

> I haven't had many professional development experiences that have been beneficial. Well, in that monthly thing, yeah. I'm trying to think the things we did. One time we did an activity, you might have even played it. It's like a multicultural-type game and you split into two groups. They each come up with their own culture and they have a weird language and so you kind of learn how to do your culture. Then you send representatives into the other rooms and they live in that culture to kind of see what it would be like to be a minority; to be out of your culture. I mean it seems like it's a good activity but in the realm of scheme, we know that it's a hard thing. It's not something we needed to spend a day doing.

Indeed, many teachers indicated that they were not happy with some of the professional

development activities, especially the ones that seemed pretense. Teachers shared that

those types of activities left them feeling embittered, resentful, and unmotivated because

they were not meaningful or helpful to their teaching and their profession, and the

discussions and experiences did not lead to any significant learning results. Grace,

experienced teacher, also shared some of those experiences. She referred to those

professional development activities as "cheesy" and shared that she much more valued

teacher conversations and mathematics-specific activities instead:

> One of the things I do not like I think of them as some of those cheesy activities that you do to get to know another person. To me, I don't care if you're from Texas or, you know, they always do those games that you've seen Elvis and your challenge is or whatever it may be - little silly things to get to know you. I would get to know you better to work on a problem with you and then I could spark up a conversation that I was interested in, 'Oh I teach that subject too', instead of those. Maybe it's just me. I think it's a waste of time, because teachers' time is precious and I like to just jump in.

Zane, experienced middle school teacher, had an example of a presentation that she really

liked and enjoyed. She mentioned that perhaps she did not learn much from the speaker

per se, however he was motivating and encouraging, leaving Zane feel optimistic and

positive about her teaching and career:

Sometimes you pick the speaker rather than the topic because you knew the speaker was good no matter what they talked about. I went to a conference a couple years ago, and one of the keynote speakers was Zal Usiskin from University of Chicago, and when I was doing my undergraduate work, his books were the topics. Everybody talked about the transformation of geometry, a lot of schools adopted those programs. It was really fun to just hear him talk in person after using his materials, and reading a lot of his articles and stuff, it was fun to hear him talk. He is really entertaining too! Do I need to use his ideas in my classroom? Maybe not, but the bottom line after hearing him speak, it really shows why you like teaching math, because it's just fun. And that's what he projects. So it's kind of like, well what did I learn? I'm not sure, but I know I feel good about teaching. That's the bottom line. Professional development should always just reinforce that you feel good about teaching, you feel good about working with kids or adults or whoever your audience is, and that you want to do more.

Another pattern emerged in regards to teachers responses about professional development in a format of book studies and discussion groups focused on literature. Several teachers shared that book studies have not been effective so far. However, most of criticism came from novice teachers. For example, Ava, a novice teacher, mentioned a book study professional development she did not enjoy, not only because the teachers involved were not mathematics teachers, and the reading was not relevant to her classroom teaching:

The worst one I attended - adolescent literature discussion group. We pick a young adult novel, we'd read it, and then we'd get together next month and talk about it. And then we'd pick a new one. It was enjoyable, but it got to be a little bit too much for me. I just kind of lost track of it. And it wasn't something that I used in my classroom.

Another novice teacher, Kelly, shared that her book study discussion was also a negative learning experience:

Last time we were supposed to talk about an excerpt from a book. Well, not only was the excerpt boring, but it did nothing except bash the profession of education and told us all the things that we were doing wrong, and we were supposed to apply this to our school. Well, how many teachers sitting around a table, who have just read this horrible excerpt about how bad education is, are going to sit there and say, 'Yeah, I do all these things in my classroom. Tell me what to do better'.

These responses indicate that some models of professional development, such as book studies and group discussions, can be ineffective depending on the group of teachers involved and the topic (or book) of discussion. Opportunities where mathematics teachers discuss literature that's specifically related to the teaching of mathematics were rated as more effective than the opportunities that involved teachers from different content areas learning and discussing general education literature.

Another pattern emerged within teacher responses related to engaging the teachers into the crafting of professional development agenda. Both experienced and novice teachers indicated that professional developers need to focus the learning opportunities on teachers' needs, therefore they need to communicate with teachers about the nature of their needs, what exactly those needs include, and ways to address them.

For example, Pansy, a veteran teacher, mentioned that teachers are typically not involved in the development and design of the professional development. She specifically mentioned the importance of teacher engagement and collaborations with the professional developers, along with valuing teacher voices and building teacher learning communities:

> I think when we didn't have any input into the professional development – when we don't have any input into what we think we need to do – those are the worst ones. The good ones were more hands on, or we had some input into what we wanted to talk about. I think the worst ones are the ones that are dry lectures. I'm thinking of some of the ones that I've been to at NCTM. I think the ones where you don't have any input are the worst. Where you just have to go and listen. I think they call it 'sit and get'. You sit and you get told.

Another example regarding similar matter was from a novice teacher, who indicated that to her effective professional development so far has been community-centered, where teachers get together to discuss teaching ideas, share pedagogical and mathematical

thoughts, provide instructional feedback, and simply offer professional advices to each

other. She mentioned not being fond of conferences specifically because those did not

offer such opportunities, especially for teachers to be able to bring ideas and share them

with each other:

> Ideally this is what our after school collaboration time should be used for, but I don't feel like they are. At the same time, it's also nice to be able to meet with teachers across the district or teachers across the state, like when we have our conferences together and everything. Maybe I just overlooked it when I went to the NCTM one, but I don't think I've been to a professional development where the topic's out there, and you're told, this is what we're going to talk about, bring some ideas, and then just have it be a big discussion group. I think it's always just been presentation-based, here's the idea, take it or leave it sort of thing. (Casey)

Another pattern emerged from teacher interviews related to effective professional

development focusing on fewer topics or issues but moving further and examining those

issues in-depth. Several teachers indicated that typically the focus and goals of

professional development are too overwhelming and large, so that the problems don't get

fully resolved and the topics typically don't get discussed and discerned to their full

potential:

> Some of the stuff we do with our school, like the district run in-services. A couple days before school starts we have four work days where teacher have to do stuff. And there's one of the days they always make all the math teachers get together and do an in-service. Typically we'll start an idea at that meeting and throughout the year a couple of times we'll meet again on stuff. It doesn't seem like there's a focus to them. I would think if I was going to develop it, you'd find one problem that you want to work on this year or one issue or whatever and everything that you do would be 'How do we address student motivation? How do we address homework issues? How do we address this?' and take a look at that and develop some strategies. Maybe in August when we meet talk about, 'this is a problem, what are we going to do to fix it?' And have everybody figure out what we're going to try and have everybody come back in September and say, 'How's it going?' Then come back in October and, "How are we going to switch things?" So that would be a good thing. If you know that you're audience is going to be together for a year, have a yearlong picture of what you're going to do opposed to

a little snapshot, 'We're going to talk about this but not really do anything. Tomorrow we're going to talk about something else and not do anything' (Pat)

Teachers also suggested that effective professional development, especially the one that is focused on policy, must allow time and opportunity for the teachers to "see" the end-product, even if the end-product is unsuccessful. Michelle shared her negative experience with district-sponsored professional development, which focused on reviewing curricular program for secondary mathematics:

> There's sometimes when I'm just like, 'Ok, I don't get this.' If you look at this state, this was over I guess one year. We met to evaluate the secondary math program, so these were either during the day or they were after school. We spent a lot of time making up a survey that got sent to students, parents, faculty, etc. We never really got to see much of that. I know it's somewhere and we can go to it, but we never discussed it and said, 'Here's where they rated us down, and maybe we should do something to address this.' So, sometimes we spend a lot of time doing things that we don't see any outcome from, and that's frustrating.

These responses indicate that teacher learning outcomes are important to the teachers themselves. Teachers do not rate professional development opportunities if they do not ensure results and outcomes, so that teachers do not feel as if they wasted their time. Several teachers talked about professional development being able to offer teachers new ways to produce student learning of mathematics; whereas other teachers mentioned bringing existing artifacts of student work in their classrooms to discuss and develop specific strategies to address students' learning needs. Michelle, an experienced teacher, provided an example of a professional development she found effective and "good" especially because of the opportunity to review and analyze students' work:

> He asked us to bring student work from something that we had done in class. We brought it in and we kind of explained to the group what it was we did in class, what we were trying to accomplish, show the student work, talked about whether we felt it was successful and then we got feedback from the rest of the group about what we could have done to make it more successful or what we could have tried differently. That's pretty helpful - that's good stuff.

Michelle specifically talked about professional development being effective because it was focused on the existing problems she was having in her classroom that she got to present and share with other teachers and obtain their feedback and ideas about helping her resolve these problems. Carter, a novice teacher, also talked about professional development focused on student learning; however he specifically talked about effective and successful learning through collaborations with his mentor-teacher:

> It's finding what's reaching the kids the best. If I get other teachers' input, that's important. If another teacher tells me, the students in my class had problems learning this concept, and this is how to fix it. That's what's helpful to me. You know, having Colin [his mentor-teacher] in here who can give me instant feedback on how my lesson went, and where I could've been stronger, what I missed with the student, one of their questions, things like that, that's been the most helpful thing. It's automatic feedback on what I'm doing in the classroom. Nothing's going to help me more than that. Because when I go to a presentation or something, they don't know what I'm doing in the classroom. But Colin sees it, and he can tell what I did wrong, and what I did right.

As part of the induction program for novice teachers, the district assigned a mentor-teacher to help Ian during the first two years of his teaching career. Carter revealed that having this mentor-teacher in his classroom and getting immediate feedback from his mentor was the most effective professional development he experienced so far.

One of the patterns emerged from the interviews with the novice teachers was, unlike experienced teacher, the novice teachers inclined towards having teacher educators provide specific ideas (or scripts) on how to apply their suggestion into a classroom. For instance, Carter specifically stated that professional development meetings were not as useful to him as Colin's feedback, because the teacher educators did not provide specific instructional suggestions for him to take back and immediately apply in his classroom.

Ultimately, Mindy's description of learning echoed many teachers' representations and responses about effective professional development features. She indicated that active engagement, problem solving, and opportunity to work with other teachers were the topmost features of effective teacher learning:

> I have to be actively engaged and not just decide on this and discuss this in your little group, or your table - but more, 'Here's something, work on it. How would you view it if you were a student? How would you view it if you were…, you know?' To have it analyze different aspects of something, be it curriculum, be it how you set up the values of whatever you see, like anything that you're forced to think about and put into my own words or own thoughts and sharing.

In summary, several central features were evident from the teacher responses about effective professional development: a) student-centered professional development attending to the ideas and concerns related to student learning of mathematics, b) teacher learning in a group of other mathematics teachers or as a mathematics teacher community, c) novice teacher induction programs have been rated as effective professional development by the novice teachers.

Context-specific features of effective professional development. In addition to teacher responses about content- and process-specific features of professional development, they also provided detailed descriptions of learning contexts that teachers found conducive and helpful to their professional learning.

The topmost feature of context-specific professional development was teacher community and learning within a community. For example, teachers indicated that effective professional development must be community-centered and occurring on a regular basis. Kim, experienced high school teacher, indicated that participation in the Professional Learning Community (PLC) meetings (at her school) have been by far more helpful and effective professional development than any other opportunities she recently

experienced. She shared that these PLC meetings not only provided her with opportunities to discuss teaching and pedagogy with her colleagues, but they have been frequently recurrent, which actually helped keeping the goals and foci of the professional development in the forefront:

> We are together in a once a month meeting with other people that just happen to have the same conference hour that you do and then we're getting more direction than from our assessment for learning committee about what we need to be doing weekly in our PLC meeting.

Some teachers shared their community learning that were not successful. For example, Kira's professional dialogues at their school were not as helpful because of the unclear agenda of the professional development organizers and irrelevant (to the teaching of mathematics) task that the teachers were not motivated to complete:

> We have these professional dialogue groups at Linden High School that meet for an hour after school once a month, and ours actually likes to meet early in the morning before school starts because we do so much after school. These were district teachers from all over the building. We're all conglomerated together, and we had groups of about fifteen, and the very first day of school when we had our big Linden kick-off day with all the teachers it was great because we were getting to know other teachers and we were learning about our characteristics of each other, and it was wonderful. Personality characteristics, that's what we were talking about. And these are the same groups that we're supposed to do our faculty dialogue groups with. We're given an agenda. I don't know who makes the agenda, but the teachers are given notes that day about what we need to talk about. The agenda is spotty at best. It does nothing to help the teachers be better teachers, get to know each other better, which I don't want to spend an hour every month getting to know the same group of people, really.

Kira also shared that for her effective learning experience instead was during her collaborations with mathematics teachers (content-specific) and involving a truly meaningful (to her teaching and profession) task or a project that allowed teachers collaborate and work together. She also mentioned the opportunity for the teachers to participate in putting together the agenda for professional development.

These responses indicate that if the agenda of professional development is not flexible and the teachers played very little role in developing that agenda - the community-centered teacher learning may not be successful.

Second feature that teachers mentioned was related to the size of the teacher learning communities. For example, Mary, an experienced teacher, talked about learning in a smaller, more intimate, group of mathematics teachers, where she's provided with an opportunity to examine instructional activities and think about the implementation and suitability of these activities to her classroom:

> I think the ones that were the best were the ones that are a little smaller, more intimate, have the activities where they give you strategies or give you something to work on, an activity to work through, that you can take back to your classroom and use with your own kids and then adapt them if you need to. If you know this didn't work exactly the same way, what are some ways you could adapt it for your kids? Or sometimes I just look at it and play with it, figure out what's something I could do with it and adapt it. Sometimes it'll just give me start and then I'll generate an idea and think, "Oh, I could do this. Or I could adapt this so that we could use it for this," that kind of thing, but the hands-on, something that I can take back to my kids, and I've worked through it so I know how it works, and I know how they might think through it, so I can then teach it and have them do it, and then say, "Ok, or I can adapt this and make it work for another lesson," and that same idea.

Similarly, many other teachers suggested that the learning community should be smaller and consist of teachers who share the same content areas and educational interests. Mia, a novice teacher, also talked about the importance of the community size to achieve effective professional development. She provided an example of a national conference she attended, during which there was no space for her to sit, she was unable to hear neither the speaker nor the information he presented:

> The sit-and-get and I've been to some where they were so crowded there was standing room only, and you were in the very, very back, and you really… One, you could hardly hear, and two, the copies ran out before they got to you for different things, or you couldn't do the activity because there were too many

people in the room so it was just more of a talk, talk, talk, and then it's writing it all down so that you could remember to bring it back and try it, because I lose focus with that kind of thing because it's auditory, but then I feel like I missed out. I can think of examples, going to the middle school conference. You go and there's math stuff and you're like, "Oh, yeah," so several of us would go to it and then we'd get there and it's just a packed house and you're like, "Ok, how much am I really going to get out of this one?" and then I'm thinking, "Well, I should have gone to my other choice, maybe it wouldn't have been so crowded." By the time you leave there, other people have done the same thing, so then you're kind of like, "Ok, I'm not going to get as much out of it as I thought I would - there is too many people".

Another suggestion that came from a veteran teacher, Colin, was related to the materials the teachers had to bring with them to the professional development session. He talked about two important features: an opportunity to create mathematical tools with everyday "kitchen" objects or items, and an opportunity to demonstrate students how to apply and use mathematics on a daily basis.

There was no commercially available product and what that did for me was that told me I don't have to have a computer program, I can use the materials that I just have around. I call them "kitchen materials", things that you find around the house. The other thing that struck me was, if I can actually find a reason to use the math and I can use kitchen materials to have the students send me away doing something, they don't need me to go out and build an 8 foot wall, but if you want to straighten an 8 foot wall, you get the diagonals. So you measure them and then you put everything in place. Well you can do the same sort of thing, just with Straws or Spaghetti or Popsicle sticks. So the two things that struck me were number one, I didn't have to have commercially prepared manipulatives. I didn't have to go buy something new. And two, if I could find a reason to use the information, then I could use that as a way to present it to kids.

Colin specifically mentioned not needing to buy separate materials but instead create mathematics from commonly used household objects and relate mathematics to everyday life.

Debbi, a novice teacher, shared that professional development organized during the contract hours by hiring substitute teachers does not necessarily ensure teacher learning:

When we had it once a month and we had to go over to district office, those were bad, those were really bad. In fact, I think there were a couple of teachers that even drank before them. Yeah, there was no point; absolutely no point. Other teachers never took it seriously when questions were asked. No one answered seriously because it was such a joke, such a useless time. I think a lot of the teachers were a little bitter because we had to leave our classes; we had to get a sub. To take us out of classes just wasn't what we wanted.

Overall, teachers suggested that the context of the effective professional development include teacher learning community that is smaller and more intimate. The teacher community is also comprised of teachers, who share similar content areas and pedagogical interests. Moreover, the teachers also suggested that they need to partake in the process of developing the professional development agenda. Teachers indicated that the agenda must be flexible, clear, and achievable.

Additional features of effective professional development. Additional features referenced by teachers were related to the descriptions and brochures of professional development. In particular, both experienced and novice teachers expressed frustrations with the descriptions of professional development, which (as teachers indicated) often times were misleading, and, in most cases, were deceptive in comparison to the advertised learning experience. Teacher responses regarding this matter, included national and regional conferences, as well as organized or sponsored speaker presentations, and in-service sessions.

For example, Colin, a veteran teacher, with more than twenty years of experience, responded to my question about conferences:

I: Do you find national conferences or regional meetings helpful?
P: They are when I choose wisely, but for some reason I tend to choose things that I think are going to be interesting that don't end up being interesting.

Teachers indicated that at times it was difficult to obtain a clear image or perspective on what the professional development exactly was offering. Some teachers even talked about feeling "cheated" by ambiguous narratives (and flyers) for professional development that looked appealing, however did not meet teachers' expectations. But, most importantly, teachers talked about feeling "cheated" by using substitute teacher budgets, and personal days and own monies to attend some of the professional development, which resulted in wasted time and expenditures.

For example, Aiden, a junior high teacher, also a department chair, was especially annoyed describing one of these opportunities that not only he (himself) attended but encouraged and signed up other teachers in his department to attend with him:

> The problem with it was that it was designed for an entirely different audience than us. It was an ELL how to teach math to English or people who don't speak English, essentially, ELL or ESL. The problem with it, it was designed as if schools had a self contained ELL program. Like all the people who don't speak English were all in the same classroom and it was designed with a very traditional curriculum. The way that we do it here, basically every ELL student that we have is mainstream, so they're all in the regular classroom and most of us use a reformed curriculum. The way it was set up, it would probably have worked well if our school fit they way they were thinking. There were lots of great ideas but I think there were five teachers from the school and the entire day we're there we kept saying, 'These are great ideas but they don't work for us.' So it's talking about taking these worksheets and rewriting your tests, and rewriting your book, and rewriting this - and those are great ideas but we can't use them. So that was a problem

This excerpt was an explicit example of a case where the description of the professional development was not detailed (or clear) enough to provide specific information for the teachers about the goals and purposes of the professional development and help them make informed decision about participation and attendance. Unfortunately, their final decision not only affected their learning, but also left these teachers feeling disappointed about the loss of their teaching days and personal finances.

Consequently, the majority of teachers spoke about the need for the descriptions of the professional development to be accurate, detailed, true, and simple to understand. Many teachers indicated that they would like to see professional development flyers become representations and reflections of the in-service learning experience to be expected, rather than a "sales pitch" to attain teachers "buy in" and to ensure teacher participation and turnout.

Another feature discussed by the teachers was related to the teachers' participation in professional development. Many teachers (23 out of 32) mentioned that they wished the district-sponsored professional development was scheduled during their contract hours. The teachers also shared that, even though many of them try hard at attempting to attend all scheduled professional development, they explained that they believe effective professional development must be built-in to their work day and not be inconveniently scheduled during week-ends or summers:

> Talking about how PD can be built into a day. I'd love that. If I didn't have to go because I'm paid, I'm here; use my time wisely, I'll do it. And I talked to other people about it and they say, "It would cut into my copy time, you know when I'm making copies. Who cares? Come here early, or make a plan for a week and then make your copies. On top of that you probably shouldn't be making a bunch of copies anyways because that doesn't promote a lot of higher order thinking". If PD were built into the day, I'd love that (Mary).

In fact, teachers continually spoke about different options they were wishing the district would implement to weave in professional development into their work hours. However, teachers were unable to agree upon any specific options that would satisfy all of their needs and requirements. Some teachers suggested postponing teaching every day until late morning to make it possible for the teachers to meet in groups for professional discussions. Several other teachers suggested arranging half-day school days, so that the

teachers have a few hours to spend together and make the learning experience more

sizeable and meaningful. On the other hand, a number of teachers complained that half-

day teaching is dysfunctional because the class periods are too short to achieve

significant student learning, and the students are too fidgety and impatient lingering to

finish the day early. However, teachers also revealed that they are completely aware and

understand the finding "ideal" time to satisfy *all* of their schedules, needs, concerns, and

desires was not going to be easy or perhaps not going to be possible:

> I think that's one of those, the reality of the world, if you make it a voluntary system and tell people, "if you have time come after school; or if you have time come on Saturday," and no one shows up. And we did both of those, we've done Saturday meetings and after school meetings. The reality of the world though is people can't make it. So if you want to make sure every teacher is there and every teacher has similar exposure you pretty much have to do it during school and get subs and pull teachers out of their classrooms. As a classroom teacher though, I think that's a very, I don't know if annoying is the right word, but it can be a difficult thing because your regular classes can't just continue when you're not there and a sub effects things differently and there's some pacing issues that affects kids who don't understand so well. So it can be very frustrating to have to basically take that day out of the school year and use a sub for it. On the other hand, how else are you going to guarantee everybody gets it? The summer ones were nice but even in the summer you have the same issue that you can't make everybody show up (Alexis).

This teacher mentioned that perhaps the only solution to the incorporation of the

professional development into the teachers' working schedules was to hire substitute

teachers, which she was not keen on, but she knew it could serve as a partial solution to

the scheduling problem of the professional development. However, the model of hiring

substitute teachers was found to be the least desired, actually abhorred by several

teachers:

> Well, if the timing is right, I think it's great. But how can the timing be right for that many teachers, that's what becomes the problem. If it's the day that you're giving a quiz, you feel like you don't have to be there. Or in some cases they take us out for half day, and some of us just were at conference areas, that happens to

> be in the day that takes half of the day they take us out. So we're not losing time with our kids, and that's great! The fact that it's not cutting into my time after school, but it's not – it's never going to be perfect for everybody. So somebody's always going to be the disadvantaged, when that happens. And some teachers just say I'm not going to go, well then if it's something we want everyone's opinion on, then everybody else's time is wasted and they're there, yet it's not a thorough discussion. So it's like an all or nothing thing. So although I think the philosophy is good, it's got some flaws that I don't know you can get past (Lindsey).

In fact twenty seven (out of 32) teachers, regardless of their teaching experience, agreed that hiring substitute teachers model was not functional or effective for them. Teachers suggested that "preparing" lesson plans for substitute teachers and then "repairing" those same lessons afterwards, due to inappropriate enactment by substitute teachers, was not worth their time, effort, and money.

For example, one novice teacher shared that for him the substitute teachers were too unreliable, especially because he was teaching from a reformed curriculum, which required much focus, familiarity, and concentration from both the teacher and the student. He also suggested that, as a novice teacher, he was still learning about the structure and the teaching philosophy of his curriculum and the mathematical scope and sequence of each lesson, therefore he did not want to lose sight, pace, and control by hiring a substitute teacher to interfere:

> I'm still at the place where being new to teaching still, I still feel like I need all the control as far as, I need to know what's going on. Especially since I don't teach any traditional, so I can't leave them a practice worksheet and say work on this for the day. Everything is a new concept, and for the same reason parents can't help them with it, subs can't help my kids with it either (Gavin).

Indeed, many other teachers stated that the substitute teachers were unreliable and they did not trust them. Teachers indicated that leaving their classrooms to substitute teachers required a lot of work on their part. Pansy, a veteran teacher explained, "I liked doing it on Saturdays and I hated doing it on pull out days, because then you'd have to do sub

plans and you'd have to leave your kids to go do it". For Pansy leaving her students with

a substitute teacher meant a "wasted" day in terms of achieving any meaningful teaching

and learning.

In fact, being out of their classrooms, and not being able to teach their lessons,

and not trusting the teaching quality of the substitute teachers, in addition to the

enormous time and effort it required teachers to spend preparing lessons for the substitute

teachers to be able to teach, were the top reasons provided and proposed against the

substitute teaching model of professional development:

> I like things that are here in the building, that are convenient for me. When I was in a smaller district I was involved in a lot more state level stuff or regional type stuff. It seemed like they always wanted to do it during the day on a school day. "Let's get a sub and go do this." I hate getting a sub and being out of the classroom, that's ten times more work for me to have to prepare for a sub then for me to actually be there. And it's so much more trouble to get a sub and take the day off. I always preferred Saturday workshops or after school workshops; stuff that I can go to that don't involve getting a sub and being out of the classroom (Susann).

The next excerpt is a specific example of a teacher explaining the time consuming task of

preparing a lesson plan for her substitute teacher. Likewise, she also stated that it takes a

lot of effort, time, and energy to create a detailed and thorough step-by-step lesson plan

for a substitute teacher to understand, and most importantly be able to implement

properly. Similar to other teachers, she also shared that she was tired of substitute

teachers incorrectly and inappropriately implementing her lessons, in which ultimately

the invested means did not justify the results:

> The amount of time you invest to make your sub plans, if they're going to be any good at all, you invest quite a bit of time to write up the sub plans. And your kids didn't make it as far that day if would have been there. Then you come back the next time and you're still trying to fix what happened. So you've got some draw backs to your class and your kids and your pacing and then you've also got the drawbacks from your time that you've just committed to writing up the sub plans

and then dealing with the aftermath of you being gone. Teachers always say, 'We come to school sick all of the time because it's easier to come than stay home.' (Mary Lou)

Ultimately, the teachers spoke positively about professional development opportunities they have had so far, however several patterns emerged from their responses that indicated that teachers' perceptions of what constitutes "good" or effective professional development influence their learning. Moreover, it was found that teacher learning community affects the implementation and success of professional development and played an important role in teachers' overall participation in professional development as well. It was found that teachers perceive an "ideal" professional development to be built-in to their contract hours (without compromising their teaching), it must carry a narrow but clear focus related to teaching mathematics and students' learning, and the teacher community must be at the heart of its structure, organization, and learning.

Overall, twenty five (out of 32) teachers voiced that incorporation of the ideas useful and specific to their classrooms, made teacher professional development effective. However, teachers pointed out that simply sitting and listening to someone talking about these ideas was not effective and definitely was not perceived as successful teacher learning. Teachers suggested that engaging in teacher discussions about mathematics, obtaining and exchanging ideas and opinions about teaching, and creating meaningful opportunities for the teachers to share those instructional ideas, were by far more helpful and effective than simply listening to someone telling them about it or reading it from the overhead projected slides. Such complains and suggestions were common from both experienced and novice teachers.

Assertions: Why Did Mathematics Teachers from this District Want to Learn?

Assertion 1: Teachers were motivated to learn for three main reasons: learning to improve teaching and student learning, learning to improve their qualifications and professionalism, and learning as a result of accountability.

Teachers indicated that the topmost reason for their professional learning lie in student achievement and student learning. Teachers indicated that continual professional development helps them improve student learning. Teachers also indicated that teacher learning is needed to stay knowledgeable and current on the developments in the teaching career. However, teachers also mentioned that their schedules are extremely busy and a healthy dose of district or school requirement to push them to learn is needed. Moreover, teachers suggested that perhaps qualitative requirements, such as teachers trying a new instructional method, are more effective and encouraging for learning than quantitative requirements (such as number of inservice hours, and credits).

Assertion 2: Teachers rated professional development that focused on the mathematics teaching as more effective.

Teachers suggested that professional development that focused on the topics related to their classroom teaching, specifically mathematics teaching, were more effective. The topics teachers mentioned included: student learning, curriculum, technology, classroom management, mathematics, instructional strategies, assessment, and teaching approaches and philosophies. These topics mirrored teachers' responses regarding their professional needs for learning.

Assertion 3: Experienced teachers, unlike novice teachers, were more flexible in regards to the implementation of the ideas and recommendations they learned during professional development.

Novice teachers specifically mentioned effective professional development needed to provide detailed instructions and information on how to implement the new ideas into their classrooms. Experienced teachers, on the other hand, indicated that they were willing to try and adapt the new ideas into their classrooms. Moreover, experienced teaches mentioned that professional development content does not necessarily need to include ideas for classroom applications.

Assertion 4: Teachers indicated that the topmost desired process of learning is to be able to work together – as a community.

Teachers suggested that opportunity to work with other mathematics teachers (in the building and the district), share ideas, and solve common and challenging problems both mathematical and pedagogical is one of the most effective professional development opportunities. Teachers indicated that they need to be part of the development of the professional development agenda. Teachers also indicated that the learning communities need to be smaller, more intimate, and include people who share similar content areas and pedagogical interests.

What Did Mathematics Teachers Want (or felt a need) to Learn?

First and foremost, the data analysis indicated that teacher' responses about what teachers wanted to learn (their professional and learning needs) differed depending on their preparation, knowledge, and years of experience. Novice teachers primarily wanted to learn about mathematics teaching, issues related to teaching, and how to become a better mathematics teacher. Experienced teachers also wanted to learn about these issues, however they were more expansive in regards to what exactly they wanted to learn, particularly situating their needs within mathematics, and their school and district contexts.

For example, both experienced and novice teachers wanted to learn about students' mathematical learning and thinking. However, novice teachers spoke about student learning in general terms (e.g., group work, motivation, classroom management), provided one or two examples of student learning, they observed in their classrooms. Experienced teachers, on the other hand, spoke about student learning more articulately, providing examples situated within mathematics and connected to their school, district, and state contexts, policies, expectations and requirements (especially standardized assessments). Therefore, even though, the learning needs of experienced and novice teachers were quite similar, their nature and descriptions were different depending on the teachers' years of experience.

Moreover, experienced teachers, who were taking on roles of leadership, such as coaches, mentors, department chairs had additional professional learning needs related specifically to these leadership roles, duties, and expectations. Based on these observations, I separated the findings from this section into subsections describing

common learning needs of teachers and *additional* learning needs of teacher-leaders and structured my findings mirroring the framework of the study: the learning needs of teachers at the individual level, the learning needs of teachers at the community level, and the learning needs of teachers at the policy level.

Learning Needs of Teachers at the Individual Level

  Student learning. The top need voiced by teachers was learning about how to deal with student learning, motivation, and classroom management. Some teachers talked about these needs in general, providing overview of main themes they are noticing in their classrooms; others were more specific and wanted to learn about explicit strategies and methods depending on the specific issue of student learning that troubled their teaching. More specifically, novice teachers' responses were more broad and vague at first, when asked to specify they narrowed their answers to include examples of student learning within their classrooms; however their examples were not content- or mathematics-specific, but more in a form of general pedagogical issues faced in a mathematics classroom. Experienced teachers on the other hand, spoke about student learning situating it not only within their classrooms, but specifically within mathematics or content-specific issues and in some cases also situating the issues within their school, district and state contexts and provisions.

  For example, Mindy, a novice teacher, at first responded to my question broadly and generally, "I think at this point my needs are resources - places that I can go, websites, books, that I can get activities and workshops that I can find to go to". However, when I asked for more specifics, Mindy mentioned students' cooperative

learning and ways she can improve on getting students to work in groups and learn from

each other:

> Little classroom things, like how do I get my groups to work better, how do I get
> my kids to make it a more kid oriented than having me as a focal point of the
> class, how do I get my kids to teach, how do I get my kids to take control of the
> classroom. Those are the things I need; resources and how do I let go, especially
> for the integrated math, and have my kids take control of the classroom. Those are
> the things that I'm looking for right now.

Mindy's response was more targeted for general pedagogical issues related to student

learning rather than mathematical issues related to student learning. In other words, her

response was not specific to mathematics but rather specific to a classroom where student

happen to be learning mathematics.

Similar to Mindy, who was struggling with classroom management as she put

students to work in groups, Mike (also a novice teacher) was concerned with general

pedagogical issues related to student learning, such as problem solving, and better

structure and consistency in student learning. He commented that he believed engaging

students' in learning involved higher order thinking. He pointed out that his trouble with

students' involvement stemmed from curriculum lessons not being challenging enough

for his students, and that he would like to learn more about addressing curricular issues

related to student learning:

> There are some issues with behavior management, there's no consistency. We try
> to have consistency. I don't even feel like I could address it. And so that's a
> starting point. What are we doing, how can we best support kids and students, at
> the very least, to be paying attention and be involved in learning. Other things
> would be developing lessons and activities that promote higher ordered thinking.
> We have some lessons that are good but not every lesson that we do is
> investigation based, nor should it be, but there are still some things you can do to
> change those lessons and make them higher order thinking. To make them more
> investigation, not investigation, more problem solving! Still a lot of what we do is
> teachers in the front of the classroom, giving instructions, reviewing how to do a

problem. Then what's the total participation rate? You're lucky if you get 50% of the class that's involved and actively thinking. Just trying to develop lessons that are like games and make them deduct and think at a deeper level.

Mike's and Mindy's concerns were similar, especially in the way that both teachers wanted to retreat from the teaching style where the teacher was the focal point of the classroom and let students take a lead on the learning and teaching. However, each teacher's responses were also similar in their recognition of student learning issues largely related to pedagogical aspects rather than content-specific (mathematics in this case).

Similarly, Kelly, another novice teacher, also voiced that topics related to student learning were at the top of her learning priorities. Kelly, specifically mentioned students' struggles with mathematics and their motivation , which she believed stemmed from having a wide range of students with different mathematical backgrounds in her classroom. She wanted to learn about differentiated instruction and how to implement it in her classroom to be able to reach and engage the low and high achievers:

> Classroom management would always be nice. Different learning styles. I would like also to learn about differentiated instructions, like how can you have higher level thinkers with lower level thinkers? And be able to have both of them be successful. And you know really challenge the higher level thinkers and not lose the lower level ones.

Differentiated instruction was mentioned by half (6 out of 12) of the novice teachers. They all mentioned struggling with not being able to reach different levels of student thinking in their classrooms. In particular, the novice teachers wanted to learn more about low-achieving students and at-risk students, and being able to help these students with their uncertainties and reluctance towards the subject. However, all of their examples

were general and none of the novice teachers were able to situate their classroom examples to represent mathematics-related differentiated instruction of students.

Adair, another teacher who was on her fifth year of teaching, spoke about student learning in regards to their background knowledge, preparedness, students' mathematical foundation, and their attitude towards learning mathematics. She too situated her example within the policy context of the district and the state, however, once again, not situated in mathematics:

> I have kids in my class who are in my class yet haven't met the prerequisites to be in my class. It's been really bad, and in some of our lower end classes, we've had to lose Applied Mathematics and Consumer Mathematics because they're not technically on grade level, and we've got kids who, State mandated, they have to have three credits of math, so we're being expected to go to all of these professional developments to learn how to bring up our lower end, but when you've got a kid who won't willfully, will not learn math for whatever reason, and they've got a slew of them. I cannot, in a classroom of thirty kids that are like that, get them three credits. I can't do it. They're not going to pass my class. They're not going to graduate. How do we talk about that? How do we handle that? And I don't think the State thought that through when they started making these graduation requirements as well as professional development requirements, and I don't think the district is prepared to support such teachers professionally.

Adair, at the end of her excerpt mentioned the district not being prepared to support teachers professionally. Actually, many novice teachers in this study were of similar opinion - stating that their district was not able to support their professional needs. The novice teachers complained that they were unaware of professional development opportunities available outside of their district. Therefore, many mentioned only attending the district sponsored professional development opportunities, which these teachers on average rated as "fair".

As I continue into teacher responses, including teacher excerpts with more years of experience, the responses become more expansive and extensive, including more

issues of student learning (within each response). Moreover, many of these responses

include classroom examples that are mathematics-specific, describing specific

mathematical dilemmas related to students' learning of mathematics. For example, Doug

has been teaching junior high school mathematics for over eight years, and the way he

described professional development related to students learning was to help engage

students and assist them in better articulating their conceptions and thoughts:

> I would be interested in student engagement. Like when you're doing an activity
> with a class, if there are twenty kids and fifteen are doing really good and then
> there are three or four that are off in space, what are some different things you can
> do to pull them back and make sure they're working? Another one would be
> writing, having students be able to write and describe a deeper understanding of
> being able to encourage students be able to write to express their understanding of
> the content area. But even more than to just explain it. You know, not just write it
> in a sentence to why this single problem worked out. For example, today we were
> learning the Pythagorean Theorem and to have students take that Pythagorean
> Theorem and write it in a sentence and to show that they understand with this
> problem they can take the numbers and add them squared rooted, but can you
> write it in a sentence and tell me why does it work in general. To help kids
> generalize their thinking and express it in words. The reason I say that is because
> it's always a problem. I mean, it's not just the Pythagorean Theorem, anytime you
> ask them to explain the process, whether we're solving equations, graphing lines,
> or event talking about symmetries, it's hard to get the students to successfully take
> their idea and write it out in a clear synced way. Those are some of the two big
> ones. When I say big ones, I'm thinking like fixable things. Because there's
> always student motivation for kids who don't want to be here and there's so many
> issues and you start running into that risk and you start running into; there's lots
> of stuff about reading levels and the students who are struggling are the ones who
> never learned to read - I don't even know how to start attacking those.

Doug, within his response, mentioned three specific aspects of students' learning:

engagement, ability to verbalize mathematics, generalize mathematical observations. He

also, in his mind, was aware of many more issues related to student learning, however he

did not attend to them due perceiving them as not "fixable". This excerpt indicated that

perhaps experienced teachers are aware of issues related to mathematics teaching that can

and cannot be "fixed", tackled, or learned.

Many experienced teachers spoke about the issues related to students learning, especially related to their declining motivation and achievement. Many of them mentioned student mathematical thinking and reasoning, and problem solving. Many teachers also voiced concerns with declining student motivation and attitude towards mathematics as a result of district and state policies. For example, Abbott, an experienced teacher with almost ten years of experience, was teaching middle school mathematics, had a concern about student learning specifically related to student motivation. He talked about this concern in reference to the minority subgroups in the district, with low socio-economic statuses, which he imparted to the district:

> My needs? Strategies for improving sub group performance. Our sub groups are IEP, free lunch, and our minority students - improving their performance. Whenever I mention this to the district, the response I always get is, well the things you do for everybody should help them. Well, the things we do for everybody hasn't helped them for years. So at some point we need to look at how we teach some of these sub groups differently so that they really start to understand the math. How do we get our hooks into them to make them interested? So I think that would be good.

Abott's concern about student learning was situated within his disagreement with the district's vision about teaching minority students and student of low socio-economic status. In fact, many (14 of 20) experienced teachers raised concerns related to dealing with students' learning, specifically related to their motivation and district provisions.

Some experienced teachers' responses were strongly guided by their beliefs and perceptions related to educational system and education in general. For example, Larry, a junior high teacher, who has been teaching for almost 25 years, suggested that students' motivation issues varied in his classroom from year to year, and knowing how to deal with those issues came from experience, the courses he taught, and the type of students he had in those courses:

The early years for me were getting the idea that not everybody wants to learn, and that was a shock for me because that's not the way I was. But it amazed me when I was around kids who have so much baggage that they bring from home that math problems are the least of their worries, and how to deal with kids like that is what I needed most in the early years. Now this year I don't have courses like that, I don't have kids who struggle with mathematics, and therefore, that's not an issue this year. Now it's 'How do you get under-achieving honor students to care?' They're in honors because they're smart enough to do it, but they're cool 9th graders now, and they don't really have to work hard at it. They're lazy, they're athletes, therefore, they're going to be NBA or NFL, and they don't have to worry about grades. Not as much at the honors level, but still, since I had so many honor students this year, I'm going to have more of a cross section of normal kids, which are, they might be good at math, but that doesn't mean they want to take it seriously. That's what I'm facing this year.

Larry's response indicated that his issues changed as he matured throughout the years of experience. He stated that he had different learning needs in the earlier years of his career. He also stated that some of the dilemmas related to low student achievement were no longer an issue because he did not teach those types of students this year. This indicates that teachers learning needs might be changing depending on the courses and students they teach.

A veteran high school teacher, Pat, talked about students' learning in terms of their future professions. Pat strongly believed that teaching every student more advanced mathematics courses was not necessary. He teacher suggested we teach advanced level of mathematics only to those students whose future careers not going to be at the "entry level" jobs:

We can't teach math to everybody and we're attempting to. Is there any reason why the entry level are going to know anything but fundamental math? This is the last year for consumer math in this school. After this year, algebra 1 will be the lowest math class. Is there any reason that you can think of, that a person's going to work for Walmart or the railroad or for factories out here for the rest of their life? Or be a plumber or an auto mechanic. Is there any reason why he would have to use a matrix? Don't even give me a classic example, there's no reason he's ever going to use a matrix.

These responses were found to be somewhat contradictory with the rest of experienced

teachers' responses, especially regarding teachers' beliefs about the number and the type

of mathematics courses the students should be taught. In spite of a few contradicting

responses, however, many other teachers were zealous to offer suggestions for

professional development ideas to address the stubborn issues of student motivation

concerns in their classrooms. Patrick, a middle grades mathematics teacher, talked about

a need for project-based professional development for teachers to learn how to access

students' prior knowledge. Patrick actually has done a similar project and felt that the

result helped him tremendously:

> You know, I did that project to figure out the students' prior knowledge, but I
> think it would be great if they'd do that for everyone. If we would have something
> where we did that all together. Because you need to know how to engage
> students' prior knowledge. I got the big ideas and then I looked through each
> investigation for CMP7 and 8 and integrated, although 8 and integrated I'm
> teaching so that doesn't take too long. The surface area of something they've done
> before- it turns out they have- well what about vertex edge graphs. Well this is the
> first time they've seen them so maybe we need to spend some time figuring out
> what they are. I think things like that- just so teachers know where to put an
> emphasis on the learning.

Patrick's response was achieving and extending student learning by connecting it to their

prior mathematical knowledge. Similar to Doug, he was also able to situate his

pedagogical idea within a specific mathematics example.

Likewise, Kim, a veteran high school mathematics teacher, also described

students' learning and motivation within the aspects of mathematical problem solving,

assessment, mathematical misconceptions, and getting students to work individually and

as a group:

> About teaching problem solving. I would like to make my students be better
> problem solvers. It's a really hard skill to teach. Because if it were step by step
> process for solving problems, it wouldn't be called problem solving. So I would

love to have some help with that. I know we've done a lot of group work in the past – cooperative learning. But I have trouble - it's funny, my geometry honors class is very independent work. My connected math class is very cooperative learning, and I have trouble getting my connected math kids to do independent work. Really holding them accountable for their own work, and I have my kids in geometry honors to work in true cooperative learning, because it's like these four brainiacs, all 'let me show you my way", and they have a lot of trouble following somebody else's way of thinking, or really working together, because they're all thinking about the way they'd do it.

Kim, spoke about her learning needs specifically situating them within the professional development programs her district have been implementing in the past several years. She felt that she needed to learn more about those programs, especially in regards to being able to better implementing them in her classroom.

It was evident that many teachers throughout their responses about student learning mentioned assessment and student achievement in their responses. In the next section I provide teacher responses about student assessment.

Assessment. Teachers, both experienced and novice mentioned assessment. Some spoke directly about the professional development program the district implemented for several years called "Assessment for Learning". Kim, a veteran teacher, wanted to learn more about the "Assessment for Learning" program that the district has been implementing for several years, especially related to the classroom implementation of the program:

And the assessment for learning – we're starting to get more out of that, so I know that it's gonna come down the pipe there, but I'd like some more work with working with objectives, being able to assess them, what different forms of assessment looks like. And the bigger question – how do you help a student who's not getting it? Who's not getting - they're taking the assessment, and they're scoring poorly, but we're moving on because we have better things to do. What are some mechanisms of helping students like that in our limited time?

Kim also indicated that she wanted to learn more about student assessment, especially how to help low achievers bringing them up to a proficiency level. Kim also specifically mentioned the Assessment for Learning program is probably going to be "coming down the pipe" meaning not going to last very long at this district. But she also indicated that, even though the program will most likely be terminated, she would want to continue learning more about different types of assessment and incorporating lesson objectives into the classroom practice as suggested by the program. Only four (out of 12) novice teachers talked about learning more about student assessment, and "Assessment for Learning" (*Leading Professional Development in Classroom Assessment for Learning*, ETS Assessment Training Institute). Some of these four teachers also expressed skepticism towards the usefulness of the program; others revealed anxiety in using the program due to not knowing enough about its philosophy and a great need for more professional development on its implementation. Other novice teachers mentioned wanting to learn more about assessment in regards to student learning and achievement.

For example, Hannah, novice teacher, was troubled and worried about her low-achieving students, and wanted to learn about differentiated instruction to be able to help her low achievers improving their mathematical learning alongside improving their performance on state and district assessments:

> I like to look more at the ones that are generated more for at-risk kids or low-achieving kids, because to me that's more the challenge. Reaching all the kids and making sure that, some of the kids will learn. For some of them I thought, I want something that I can walk out the door and go back and try with my kids and see if that will benefit them, because I want to try to get those low kids, I want to try to get those kids that are normally afraid in math, think math is too hard, think they can't do math, get their confidence built back up that they can. I want something that I can really use with that specific group of kids, because there's a lot of INSEP, MAP, all that. The pressure is back on. You need to really bring all those kids up to proficient - well then we need strategies that are working,

because the strategies that work for the general group don't work for those kids, so you need something else to work with those kids to build their confidence up and to get them more motivated so that you can get them to reach those levels, because some of the strategies that you've used before aren't working or they wouldn't be in that situation.

In her excerpt, Hannah spoke about challenges she faced teaching low achieving students (in her classroom) and the pressures she felt (in her school and the district) in regards to state assessments and these particular students' performance. She said, "The pressure is back on. You need to really bring all those kids up to proficient".

Zane, an experienced middle school teacher, also had issues with district assessment, however her problem was focused more on the mismatch of her beliefs about assessment of student learning and the district's scoring system. She shared that students' low motivation and achievement in the her classroom was in part a result of an inconsistency between district assessments and students' unfamiliarity and difficulty to meet the district's expectations:

It's not fair when you're sitting there nitpicking - last year, I really had a tough group of kids, and I'm sure I had the lowest scores in the district, and it's like, well what am I supposed to do? And I' m watching that this year. If you've got kids in 6th grade that can't read, how are they going to take these tests? Or if I'm sitting there and I know a kid has been really doing all the homework and understanding - and then I do the official grade thing… I curve all my test scores, and I categorize them my own way, so I have a certain amount of A's, B's and C's. Because if I'm going to just say to a kid, 'You got a D because you didn't do this this and this', I've lost the kid. I've just lost them because they don't understand the scoring system.

Patrick, on the other hand, talked about assessment in regards to gauging student learning at the end of the lesson:

Summarizing at the end. Because kids were working, you know they're going to have homework, well if you say, ok let's summarize what we did today, well they're going to keep working or they're not going to pay attention because it's the end of the hour. So how do you summarize the next day? Or can you summarize?

Michaela, another experienced teacher, also mentioned summarizing, especially related to district-developed assessments. Michaela indicated that she wanted to have the opportunity to learn and preview the district assessment pieces, so she can better prepare her students for them. Michaela also specifically mentioned that she was not good with informal assessment of students and that she needed to learn or observe other teachers assessing informally:

> I would like to be able to assess the quizzes before the tests so that I could direct the reviews better. I've never really been good with the informal assessment part other than just, you know, as I walk around from group to group. I would really like to see how other teachers do it.

The next subsection includes teachers' learning needs, for both experienced and novice teachers, related to technology. I provide a detailed description and excerpts from teachers regarding what exactly about technology they said they wanted and needed to learn.

Technology. For both the novice teachers and experienced teachers, learning about technology, the use of instructional technology to teach mathematics was the second most desired learning need teachers wanted to address through professional development. One example was a teacher, who was not against the technology per se, but was concerned with the amount of time and workload the technological tools demanded on the teachers' part:

> You increase technology, and you exponentially increase the workload. That's proven, that's a business fact. That's why businesses are trying to back out of some of that stuff, trying to get isolated developments (Pat)

Other than Pat's response, many others teachers were interested in technological

developments, and expressed desire and need to learn how to use technology in their

classrooms.

In fact, when it came to the novice teachers' needs, many expressed being

overwhelmed with all the recent technological tools and developments, and not being

able to use or even being familiar with the valuable or handy features these tools have to

offer. Novice teachers complained that the district is not offering much of professional

development opportunities on the use of technology. The teachers explained that the

problem was not in the availability of the technology-related professional development;

however, it was the lack of professional development on the use of technology

customized specifically to mathematics teaching.

> Web-based. I want them to use the online calculator, which I have the website
> now, so if I go there I can figure out. But just even there are some programs on a
> graphing calculator that I'm unfamiliar with, and I know the subjects have come
> up like in summer school, where we can do different types of activities, but I
> don't know what I was doing, so. They tell us all the time, technology,
> technology, let's use technology. But then we don't have many opportunities to
> learn, how to, or to even learn what to use. (Sidney, middle school teacher)

Experienced teachers confirmed that many teachers who come to the district, are not

proficient in the use of technology, including the use of a graphing calculator:

> Technology. Yeah, especially, some teachers come in here and they haven't ever
> touched a graphing calculator, and I don't think they realize that that's the case
> sometimes. It just depends what their background is, so they really need a lot of
> help in that regard. It doesn't happen as much as it used to, but there's also a lot
> of things that the graphing calculator does that they don't know (Kim).

Similar to the novice teachers, however many experienced teachers also indicated that

they perhaps did not know how to use a graphing calculator to its full potential either.

However, experienced teachers were a lot more eager to dive into the learning of the new

technology. Experienced teachers' responses in that regard were somewhat different from the novice teachers' responses. Experienced teachers were eager (rather than overwhelmed) with the abundance of new and different technological tools. Some of them were excited to learn about the new technological capabilities, especially regarding mathematics and assessing students in learning.

Fifteen (out of 20) experienced teachers voiced the need to have more professional development to help them learn more about the new technology that is currently available, the type of technology that is effective for students' learning, and (for several teachers) even the use of some of the tools widely available in their own classrooms (such as graphing calculators).

> Technology is the huge one. I mean, not just calculators, which I only know how to use 1/20 of what it does. How to open up that whole world of technology. I think I have students who, if they could get on the computer and do things with the computers, would just fly. I feel badly sometimes that I can't help them do that because I don't know enough about it myself. I basically use the computer as a word-processor, but I know that I have kids who could do a lot of stuff and really get into it if they had more access to computers. In order for them to get more access to computers, I have to have more access to computers. CatCam I've never played with and it looks like so much fun. It's a drawing program that architects and engineers use. I know that they have a huge program at the career center on Cat Cam and a lot of the kids are taking it. I know they have computer run laser stuff - I'd just like to know about that stuff! (Pansy, HS teacher)

Pansy (a veteran teacher of almost 30 years) demonstrated eagerness for learning even though she stated she was very close to her retirement. Also, even after thirty years of teaching, this teacher was not shy to admit that there were tools that she did not know how to use either and items on her list that she still wanted to learn.

Hank, another veteran teacher, also mentioned wanting to learn more about technology; however, his eagerness to learn was not as fervent as Pansy's. He communicated that his participation in professional development has declined and not as

regular as it used to be. He also shared that the number of professional development has

slightly increased in his district in the past a couple of years and has been more frequent

and available on a regular basis:

> Well the things that I would like to see more of I think were offered in years
> passed when I wasn't available to take them, and now I would like to be able to
> do that, like designing web pages. We have teachers that are using blackboard
> and doing web pages, but the professional development is not available in the
> summertime when I am available and I'm not a go to school at night for 3 hours
> after a day at work. That's not me. I don't like to teach that way, and I don't want
> to be a student that way. So I don't really seek out professional development
> during the school year because I have the number of activities that I sponsor keeps
> all of my afternoons after school day, Friday's my only consistent day from
> having something after school. And that's the end of a long week.

When talking about technology the responses of experienced teachers were also situated

within a specific domain of teaching mathematics, whether it was student's use of

technology, or curriculum, or even use of technology in regards to understanding real

world applications.

For example, eight experienced teachers (our of 20) mentioned curricular

programs they are currently using in their classrooms. For example, Kate voiced that she

would like to have more training not only on the use of technology, but also where (in

which lessons) would it be appropriate to use technology or perhaps when (for what

specific topics) would it be best to use particular technological tools:

> We do have a lab here that we can reserve so you could take your whole class,
> because I think too many times things are demonstrated and, again, I'm
> interacting, I'm learning, and they're just looking and not learning anything. But
> if they actually went to the computer lab, where are there some things that are
> really critical that it's ok to spend a whole class in the computer lab exploring
> something, and when are some things that you don't want to do that with? Where
> does it fit in our curriculum? In which book would be a good place to spend a day
> and that kind of thing?

Similarly, Jane is currently teaching a middle school program *Connected Mathematics Project (CMP)* (Lappan et al., 1996) and wanted to have more training on the type of technology that best accommodates the lessons out of CMP:

> I'm using the Smart Board, trying to develop Smart Board Notebook lessons for connected math. I would like to have some more training. Because I spent a lot of time searching the gallery and searching for things that I create everything from scratch. That takes a lot of time. It would be nice to have some training with connected math and the Smart Board. It would be really nice if there were Smart Board lessons created for connected math that I could just look at, tweak and apply to. The classroom assessment tool clickers, have you heard of those? Where the students have a handheld clicker for their answers and the results are presented on the Smart Board. We're supposed to be getting those classroom assessments. I can't think what they're called. But I'd like to have training on that obviously before it ever comes into my room. But even with Smart Notebook, I would like to build or show little video clips related to what we're doing and things like that. But I don't have time to find them.

Jane mentioned learning about technology, but she situated the use of technology within the student learning by showing video clips during the class, assessment or as a tool for assessment, and as part of her curriculum lessons. She indicated that she was writing the lessons from "scratch" to compliment her curriculum. Learning about curriculum was another great need that teachers mentioned, especially the novice teachers.

Curriculum. Many teachers mentioned wanting to learn more about implementation of their curriculum; however, more of them were novice teachers. Many novice teachers voiced a concern that coming into the district where standards-based curricular materials have been used for several years is the most difficult, because the district does not sponsor curriculum-specific professional development focusing on implementation. For example, Ebony, shared that it was very difficult for her to start using standards-based (integrated) curriculum without having much professional development, especially since it is heavily based on real world examples that Ebony is struggling with teaching:

175

P: I think the biggest question I always get asked is, why are we doing this? What does this have to do with me? I would like to see some sort of PD that relates, how can we help make it realistic to the kids. Give me some examples of real life situations and even though our textbooks are doing a really good job of trying bringing in more real-life situations, some of them are pretty cheesy. So maybe helping the kids, say, "Why do I have to know the square roots?" Well look, this is an actual job, where if you don't know the square roots, you won't get the job".

I: Are you teaching Integrated?

P: Yes I am. And Integrated supposedly was supposed to eliminate that. And the kids were supposed to see the real world connections right away. And they don't. I mean, you know, they assume my kids will go, "Well, okay, but when am I going to ever run a carnival" And I'm just like, "Well, I don't know, never". And I think Integrated is something to kind of back-track a little bit. Unless you've been teaching in a district, or unless you come from one of the other three districts in the nation that use Integrated. There needs to be a lot more PD for integrated teachers. Just for the curriculum. Like I would almost say that as for a first year teacher, you shouldn't be able to teach Integrated. And if it's something you're interested, you should go through a year of meetings. Because it's so different from the drill-and-kill, and I mean, it's just crazy different.

Ebony, raised a few issues that she was struggling with teaching integrated. First, not being able to bring out the real world applications and connect them to students' lives. Second, she also mentioned not being comfortable teaching the integrated curriculum, stating that new teachers should not be teaching integrated their first year. Third, Ebony does not have much faith in the teaching integrated mathematics. She also had an opinion that integrated was not widely used curriculum in the United States.

In fact, similarly to Ebony, the majority (10 out of 12) of novice teachers talked about struggling with the standards-based or integrated curricular materials and their teaching philosophies. When I sat down to talk to Danny, he shared that he would like to learn more about teaching the integrated curriculum too, and first and foremost, better understanding of his school's or district's vision of what does integrated mathematics curriculum really mean:

I think just professional development things on how to teach integrated math, because integrated math means different things to every teacher in the building.

Integrated math, some people are like, "Oh, we'll work in groups and have them do a whole investigation on their own and then kind of recap," and then other people are like, "Oh no, you've got to show them first and then they do investigation." It just seems like I have no idea what the expectations are as far as, I feel like in traditional classrooms the teacher stands up and gives everything to the student and the students take it and use it, and in Integrated math the students are supposed to kind of find the stuff on their own and they can't do it all the time. Sometimes they can. Integrated III does alright, Integrated II really almost never. I just don't know what the expectations are. If the principal came into the classroom one day to do an observation and I was standing up there saying, "This is the equation for a circle. This is what all these variables mean. This is how you use it. Now, do the investigation," would he be like, "Oh, you're not supposed to give them that equation, they're supposed to find it out on their own?"

Many novice teachers (similar to Danny and Ebony) stated that they were struggling with standards-based curricular materials and that more professional development, where experienced teachers or the district administrators "told" them how to use these materials in their classrooms, was needed. Experienced teachers also voiced the need for more learning opportunities related to the curriculum:

We need vertical training with the honors curriculum. We've got kids - I don't want to slow any of them down. We need to have vertical discussions in honors, and given me what they study in integrated 3 and integrated 4 is not the same as going to her [another teacher] class and saying, "OK this is what we're doing today". True, I've had most of the topics in integrated 3 and 4, but I actually had to sit out and work them - I've learned things in integrated 1 that I had not ever learned in math, in any math course, how to solve real world problems. That's why I'm a proponent of integrated because it's worked for me. But I'm not willing to make it all integrated because I don't think everybody needs it to be that way (Pat, experienced high school teacher)

Pat's concern was specifically related to the honors students learning from the integrated curriculum. From his response, it was evident that he wanted the community learning to be meaningful, rather than sharing of ideas to imitate. Pat wanted the other teachers to actually experience the integrated curriculum and solving real world problems personally.

Experienced teachers, similar to novice teachers, mentioned struggling with the curricular materials and wanting to learn more about its implementation. However, once

again, their responses were somewhat different from the novice teachers. Experienced teachers, after going through many hours of professional development, still felt the need to continue learning about these curricula. Unlike the novice teacher, however, the experienced teachers recognized that curriculum implementation is complex and might take a long arduous process of learning and experimentation, before they feel comfortable with using these curricula in their classrooms.

For example, Larry, a veteran teacher, shared his humble experiences trying to teach and learning how to teach using integrated mathematics curriculum. He shared that another veteran teacher, who was fond of the curriculum right from the beginning, helped him and influenced him to try the curriculum, experiment with it, and persistently carry on with it:

> I know I didn't write about Patty [another teacher], and it made me nervous, the integrated because I didn't get in on ground 4. They were teaching it 2 years before I ever had it and I had no idea what was going on. So, I didn't get the early years when they had the training in the summertime you know, and I have to admit I was reluctant to get involved in that because I believe that talented students don't need the way the core plus is set up. I can give them the best features of core plus in our traditional book in a classroom and that's just my philosophy. So when Patty had those classes, I went to them, I said I need to hear this from somebody who's doing it now, not tell me what it's like from the college level or the district level, this is what I do in class and this is what's in the book. Just knowing what is in integrated 3 and integrated 4, is helpful to where, when you're teaching 1 or 2, you know where they're going next. But we don't get enough of that. Right now we're doing matrices, multiplying matrices. I did that in college for the first time, and they're doing it in integrated 2. Since it's my first year, I'm barely ahead of them.

Larry shared that this year was his first year teaching integrated curriculum. He stated that he was barely ahead of his own students. He also stated that observing Patty using integrated curriculum and learning from her about the curriculum vision and

implementation, was a good learning opportunity that Larry said, "We don't get enough

of that".

Another experienced teacher shared that he was struggling teaching integrated,

and that he was very happy that teachers at another school, who also teach integrated

curriculum have meetings and share the meetings minutes and discussions with him via

email:

> I'm struggling with that [curriculum] right now, and it would just be fun to be
> with a few teachers to sit around and discuss this, and right now what I do is the
> Linden High teachers sit around, discuss it, and they send it to me, which I'm
> appreciative of. So we have an email communication, and I told the lady at
> Linden High, 'I just feel like I'm a leach' and she said I have her daughter and she
> had my son in '95. She said 'It's payback time', and I said 'Oh no, you're
> daughter she's easy to get along with, my son wasn't' (Hank, junior high school
> teacher)

Another experienced teacher, Nadia, also shared that learning within a teacher

community is one of the "ideal" ways for here to learn. She specifically mentioned that

she would like to learn about student thinking, assessment, and teaching by getting

together with other teachers, who teach the same curriculum, to discuss and share their

thoughts and ideas:

> It would really be helpful if, this would be the ideal for me, would be a late start
> one day every week, an hour later or something where you could get together with
> people in your same curriculum and work. Plan, do common assessments,
> evaluate student work, whatever, but sometimes an hour is not enough, so I don't
> know, it's debatable. Sometimes you have to do things outside of school time.

Similarly, Celeste, another experienced teacher, mentioned enjoying the Saturday

professional development meetings, where middle school teachers got together and

discussed lessons, teaching, students' assessments particular to the Connected

Mathematics Project:

179

Our CMP Saturdays, I enjoyed having that connection and having someone to go to as a resource, even if they weren't utilized at the meetings. I felt like it was good to have someone there to ask some questions, but I feel like it would be fantastic if a mathematician could lead us in something, or someone from the math ed department could lead some professional development. I think it would be really interesting to hear some people who actually use math in their every day. We always hear about, "Well, engineers complain that kids can't do fractions." Well, I want to hear it from them. I'd like to really hear and see what they do, and understand better so that we can prepare kids better.

Celeste, mentioned on the important aspects that were brought up by many teachers, especially novice teacher, the mathematical knowledge required to teach mathematics. Many novice teachers mentioned the need to have more professional development focusing on the content knowledge, especially helping teachers learn how to explain the mathematics they are teaching.

Mathematics and explaining mathematics. Teachers, especially novice teacher, shared that one of the biggest issue with implementation of the standards-based curriculum was the mathematical knowledge and being able to explain the mathematics and answer students' questions. One teacher voiced her concern with the materials, "The math content - I can't think of a [professional development] that we've gone to - that's just focused on the content. We've talked about how to better teach the lesson, but not hey you need to make sure you understand how to do this math".

For example, Gavin, a novice high school teacher, talked about professional development that would help him to better convey and explain the mathematics to his students:

I can do the math, and I know how to do the math. But my road block comes in, how do I get it across to the kids, how do I get them to learn it. Getting them excited about it and getting them involved is one of the struggles that I have with it. That's the road block I'm trying to overcome.

Indeed, the predominant majority of novice teachers mentioned struggling to explain the mathematics to their students. Most of the teachers felt somewhat confident about understanding and being familiar with the mathematical knowledge they were teaching, however being successful at explaining that knowledge to their middle and high school students, was a completely different matter and seemed to be a substantial area they all felt needed improvement:

> I think maybe not so much content knowledge because I feel like I understand this, but maybe getting a chance to talk about how you explain the content to somebody. Like now that you understand it, how can you make it so that somebody else does. There's plenty of things out there that I understand why it works, but I don't really know how to convey that to somebody. So that would definitely be beneficial. I think that kind of relates to content knowledge. The other one was learning how to use technology. I put that basically because our district hasn't really had a lot of technology-based mathematic instruction sort of thing. They've shown us all the technology and everything, but they showed it at a district level where they show it to all the teachers, and it's not necessarily content-specific. We had this whole seminar on Internet usage and Internet safety, and watching out for copyright things, and every single website that we went to was like, I'm not going to use this. It was nothing useful for me (Casey, high school teacher).

A few experienced teachers also mentioned wanting to learn more mathematics content, especially learning mathematics to be able to teach it. For example, Lena, a veteran teacher, indicated that she knew Calculus as a student, but did not know it as teacher and therefore was not competent to teach it:

> I think my content knowledge is right up there with anybody's. I can't teach Calculus, I could if I really wanted to, but I haven't had Calculus in thirty years, but as far as knowing what I'm teaching, I think I'm ok as far as content goes, it's just the classroom techniques, I guess. Pedagogy, more than anything else.

In summary, after analyzing teacher responses, it was evident that, in general, teachers have similar learning needs when regarding classroom teaching and instructional practices. However, the nature of those needs and their descriptions somewhat differ

depending on teachers' years of experience, not only experience teaching - but experience learning about teaching.

Learning Needs of Teachers at the Community Level

In addition to the professional and learning needs and concerns that teachers stated on the individual level, teachers' voiced a great concern a critical need for opportunities to learn together as a community and a need to build a stronger teacher community for better cooperation and learning.

Building a stronger learning community. Teachers stated that they need to be able to learn in a community, however, a stronger learning community. Many teachers indicated that, especially after adopting a standards-based curricular materials, their district, as a community of teachers, has been having difficulties communicating and collaborating. Another issue, raised specifically by novice teachers, was that the senior community of teachers have been unsupportive of novice teachers and their opinions and needs.

Susann, a novice teacher mentioned that she has been working with another novice teacher on conducting classroom observations (when possible) and getting together to talk about teaching after school. I asked Susann, why there were only two of them and both were novice teacher. Susann responded that she suggested doing this as a professional development in the building for mathematics teachers, but the department teachers did not think it was possible:

> Everybody else in our department says, "Oh, we can't do that on a big scale, it'll never work. We'll all get off." It can be done. No one wants to do it, because no one wants to be told what to teach every day. It's all about close my door, I do it my own way, which is fine but I want to know how you do it. Maybe it's great. Maybe I can learn that way. So I've done over a hundred on my own. See, and my door is locked always, but if you tell me you're coming, that's fine. The first

couple of months of school, I would say, I had several of the new teachers
unannounced just come to my door, knock on it, open up, take a seat, watch me
teach, open the lesson, watch my kids talk, talk to them. Doesn't bother me at all.
If you think you could learn from something I'm doing, do it. If I can learn from
something you're doing, I want to do it, and I hate when people try and stop that.

From this comment it was evident that the community learning is not going well at
Susann's school. She mentioned that the teachers preferred to teach behind closed doors
and discussing or modeling teaching ideas was not welcomed. Susann shared that in her
school - even though teacher support from more experienced faculty was available - the
new teachers typically collaborated together, aside from the experienced teachers, and
sometime even outside of school.

In fact, in my conversations about community learning, it became apparent that
there was a bit of a community mismatch, in several of the schools, in regards to collegial
relationships between novice (especially younger) teachers and the senior or more
experienced teachers.

Carter, a novice teacher, complained about being dissatisfied with the relationship
he had with senior teachers as well, and the way they typically treated him as a novice
teacher during the district-sponsored professional development:

Some of the teachers-it's almost like you're participating based on seniority. I feel
like if my opinion varies from someone who's been here 20 years that it's not
going to be given equal opportunity. [Pause] I don't know that they get to speak
up more, but they choose to, and not all of them, but I've had a couple who seem
to value the opinions of new teachers much less. So that can be frustrating. That's
just a couple, but it doesn't take many to ruin something.

Actually, novice teachers from four (out of 8 total) schools, talked about being unhappy
with the way their relationships developed dismally with senior or more experienced
teachers. I inquired about novice teachers' and their collaborations from other (more
experienced) teachers in the district. They confirmed that the novice teachers at their

school collaborated separately (from experienced teachers), at times even during the week-ends. However, the teachers also told me that younger (novice) teachers do so not because they are against the experienced teachers, but merely and absolutely for collaboration purposes:

> I would really love to have more time to work with the other teachers in the building. I think that's the most important thing, and I see the young teachers in the building, I mean, I'm not willing to give up all my free time to do this, because I have a family. But I see the young teachers in the building, they're getting together at night and on Sundays and they're doing a lot of this. I would like to have time during my contract hours but I know that's never going to happen.

Bailey, an experienced teacher, mentioned not collaborating with the younger teachers due to lack of time and family commitments. However, she was not at all criticizing or devaluing the young teachers or their viewpoints about teaching either. In fact, she was desirous of their collaborations. In fact, I asked the veteran (and more experienced) teachers in general about the district as a community, and what did they think about the "young" teachers' and their collaborations. The vast majority spoke highly of their novice teachers and described them as hard workers and good colleagues. One teacher for example said, "We have teachers that are just working hard, even our young ones, they're working to get better" (Hank).

Nonetheless, amongst these teachers I found one veteran teacher who was not as happy about the novice teachers in his building:

> The young ones are on top of their email because they like it – I wouldn't have email and I wouldn't have a cell phone. I would put a mosquito net over this building. There would be no cell phones in or out. I'm here to teach those kids that sit in those damn chairs and that's it, period. But we go to meetings and we do this and we do that and we do all the other things, and…we're not paid enough to do all those other things! And I know that. I taught through four decades, I've seen the 60s go by, the 70s go by, the 80s go by, and the 90s go by. And we've changed in every decade. Do your research on the sociological thought process of

the kids coming out of college. What's first now? Coming into every profession, teaching is no different: 'My time is my time. I'm not going home to do work. I'm not going to spend Saturdays here'. My family is second. I raised kids and never took one day off to stay home with a sick kid, ever! Now, they go home once a month. Once every couple of weeks for a sick kid. You've got to be kidding me. That's a different thought process. Is it wrong? No it's a different thought process. I don't understand it. My dad taught me, come early, stay late, and work damn hard in between, because that's the way his dad was. It's not that way anymore (Larry).

This teacher's response indicated that perhaps the differences in work ethics between the senior teachers and novice teachers was influencing their collegial and community relationship. This teacher also explained his disappointments with the teacher profession in regard to low salary, lack of time and energy at the end of the day, especially to spend with his children and family.

After hearing his response it was also evident that senior teachers in the district were somewhat tired of constant changes in the educational system, especially those who have been teaching for several decades (like Larry). Perhaps that attitude was also reflected on the novice teachers. From my interviews with the novice teachers about their philosophy of teaching, some illuminated a great deal of passion and support for current reform and changes in the educational system, others were not convinced but were willing to try new methods, especially if these methods were found to be effective for student learning gains.

Another novice teacher, Kira, shared experiencing tensions in the community. She described that generally, during the district-sponsored professional development, she experienced apathy and lack of correspondence from senior teachers:

Well I think one, you get a lot of older teachers in there, at least from my experience, that just feel, 'This is a waste of my time. I am not going to learn anything more, I know everything'. That's hard to compete with as a new teacher. Also, don't know, if we meet with all the math teachers it's hard to address the

needs. Integrated is so, even if you have all the math teachers here, integrated is so different from traditional that even when we meet with our department it kind of gets split into two. We can't really meet as a whole because it's different. So it's hard when you meet as a big group to address your individual needs because everybody has different needs.

Kira raised an important issue during the interview: as a novice teacher it was difficult for her to learn in a community of veteran or more experienced teachers, perhaps due to them having more experience and knowledge, and being at a different learning level that the experienced teachers. Kira also described that the problem is rooted in teachers' disagreements about teaching mathematics and mathematics curriculum, which are related to their vision and philosophy about teaching and learning mathematics and best pedagogical practices.

In fact, teacher discontent and differences related to the curricular *vision* and beliefs about teaching practices were a significant factor, that both novice and experienced teachers mentioned. Teachers explained that the differences in their curricular opinions and beliefs began after the district adopted a new curriculum, which was different from their previous one - it was integrated (not single-subject) and it mirrored the newly developed national standards for teaching and learning mathematics (NCTM, 1989). Several teachers alluded to the fact that the district curriculum decision sparked a lot of discussion, arguments, and controversy between the teachers, which weakened teachers' personal and professional relationships:

> We have worked a lot on professional development through the integrated math curriculum. A lot of support. There was a grant I talked about that a little bit that Fran wrote with Chip. We have come a long way. In fact, when I go to some districts outside of this district I think we are on our way. It's going to be a long fight or a long struggle to where maybe a certain percentage of teachers I feel are on board with some of the things we're talking about, but at least we have the conversations started. And the curriculum provides that opportunity, and thankfully Fran and Chip had the money to get us together to work together.

There is, in this school in particular, there is, I think, two camps on beliefs on teaching: what's the best way for teaching math and learning math or what math is (Pansy).

Pansy, a veteran teacher, talked about experiencing inadequate relationships with other teachers due to disagreements about the nature of mathematics and the teaching of mathematics that got set off by the district curriculum adoption.

Michelle, another experienced teacher from another school, mentioned experiencing inadequate relationships with her colleagues as well. She described difficulty to find common working ground between the two teacher-camps. She described the camps as teachers, who are in favor of the previous (traditional) curriculum, and the teachers, who are in favor of the new (reform) curriculum:

It makes it a little bit difficult to work in a school where there is that dichotomy. Many teachers didn't participate at all in the grant work, professional development. They weren't a big fan of it [curriculum], some of them have never opened up a book involving it, some of them actually are still not in favor of it but have tried to teach it, but, since they haven't gone through the appropriate professional development, they teach it in a way they're used to seeing it done in a traditional classroom. So they're not as far advanced in their thinking - it is sad. Just sad. They don't really want to learn anything new, and I think some of them in that camp also were that same way with technology and they kind of finally realized, I have got to do something because I'm getting way behind.

It was evident that teachers valued community-centered learning and perceived the community to be a vital feature of teacher professional development. However, it was palpable to note that the community-centered learning was not just about getting teachers together in a group, but instead it was about the teachers and their concerns, needs, and interests related to teaching mathematics, and their shared trust and support for each other's development. In fact, I found that if these features were not present - the community became fragile, uncooperative, and unaccommodating for learning.

As an example I use the district-sponsored *Teacher Coaching* professional development program. The Teacher Coaching professional development program was meant to distribute the leadership in instructional assistance from district administrators down to the teacher-leaders and further down to the rest of the teachers in the district. The district appointed several teachers to serve as teacher-leaders and asked them to open up their classrooms for observations by other teachers, conduct classroom visits and provide instructional feedback to teachers, and offer to substitute teach other teachers mathematics classes while they observe other classrooms. However, the Teacher Coaching model created several tensions within the teacher-community, weakening the community as a whole. First and foremost, several teachers, especially experienced and veteran teachers, felt uncomfortable with the district's choice for teacher-leaders. Many senior teachers, especially the ones who had more teaching experience than the appointed teacher-leaders, felt disappointed and let down by the district's choices and dissented against the professional development program altogether:

> I think as time goes on, it's going to continue to improve. But I think like in the fall, this whole thing was set up, but then you have to say, 'OK, now how are we going to use this? How are these people going to transition to these roles? And how are we going to transition to being coached?' And it's interesting being a veteran teacher, and being coached because there's a little part of me that wants to say, 'I know what I'm doing', and the other part of me says, 'But you can always learn more'. So it's got to find that balance. As my son goes, 'Mom you are just uncoachable'. And I think the same thing for the coaches. I think coaching is a really hard thing to do. And you know, there are good coaches and bad coaches. As a coach, how do you offer constructive criticism, so that the person you're coaching doesn't go, 'Screw you! I'm not doing anything you say'. And that's a hard thing to learn. Something like in the classroom, you know as you're working with kids, I mean often we make our mistakes, you say something and you can watch the switch go right off. But I think that the coaches, I think they're working together as to kind of presenting their coaching persona. But it's going to be rough I think for a while. It's not an easy thing for all of us to make that transition from being coached to being the coach (Zane).

This experienced teacher mentioned several features that bothered her about

Teacher Coaching. First, she was struggling to find the balance between her perceptions

of high self-efficacy, "I know what I am doing", and her perception of a teacher being a

life-long learner regardless of the learning process and the facilitator of the learning

process, she said "But you can always learn more". This teacher also demonstrated her

consciousness that every teacher makes mistakes and is aware of them, therefore a

teacher-coach must be tactful, considerate, sympathetic, and, most of all, sensitive when

providing feedback, especially in the form of constructive criticism, and she was afraid

that her feelings might be hurt as a result of this professional development program.

However, in addition to the veteran teachers' disapprovals of the Teacher

Coaching, other experienced teachers in the district also became troubled by this model

of professional development. Many of them indicated that they did not agree with the

idea of having a leader. Experienced teachers explained that they perceived their

community to be cooperative and building on team-support model of professional growth

and development, rather than the leader-apprentice model:

> I would rather it be a peer than a teacher leader and I do not know why. Do you know what I mean? Working as a team instead of thinking that someone else is an expert, because I do not think there is an expert. In teaching, there is such a learning process that when they say those 'math coaches' and the name 'teacher leaders,' it rubs me wrong, a little bit, in a way. And that goes back to how I learned, some people would say they would prefer a leader, but I would rather feel like a team. We are all learning together on a goal instead of someone criticizing. I almost think that is what it is, they would be criticizing me instead of helping me, and I think a peer would be more of helping each other out situation (Michelle).

This experienced teacher indicated several features of Teacher Coaching that bothered

her as well. First, she perceived teacher-learning to be a collective communal effort,

where all the teachers are perceived leaders, experts, and learners; therefore the Teacher

Coaching model of expert-teacher training other teachers did not acquiesce with her perceptions and expectations of community-centered learning. Second, she too assumed and was afraid the expert-leader becoming critical and judgmental, as opposed to being helping and considerate. From this excerpt it is also evident that perhaps this particular teacher did not have a collegial relationship with the appointed teacher-leader and, similar to the veteran teachers, she too was afraid of untactful, unsympathetic, and insensitive criticism, which, as a result, made her averse and indisposed to the Teacher Coaching professional development model.

After all, the negative frame of mind of veteran and experienced teachers in the district affected the novice teachers in as well. Even though many of them were open and willing to learn from the expert teacher-leaders, they witnessed and recognized the difficulties that this model posed to their friendships with other teachers in the district and felt awkward about taking sides. The novice teachers also recognized the difficulties the Teacher Coaching posed to the school community as a whole (especially within their building), and as a result, the novice teachers too became reluctant and vulnerable to participate in the Teacher Coaching professional development. Lindsey, a novice junior high school teacher, shared with me that even though she was fond of the idea of Teacher Coaching, the school community taken as a whole (collectively) was not happy and supportive of this professional development model, and became unsupportive:

> We don't do much of the coaching. I think that would be great, but I also think that's a personality thing. I see how that could be bad sometimes. I mean I can think of people in our building that I would love to team with, and that we'd have a great time. And really get something out of it. And then there would be others that I don't know that I'd be comfortable being totally honest with them. And I think I would be kind of bent out of shape if they said anything mean to me. So them coming into my classroom? It might make me a little uncomfortable, some

of them. But then again, it's a personality thing - if I feel like they were judging as opposed to helping.

Lindsey pointed that her school community became fragile, uncooperative, and unsuccessful when it came to professional learning using the Teacher Coaching model. She indicated that her school community was divided: a group of teachers she was comfortable with learning, and a group of teachers that could impair her learning and let her down in the process. From her excerpt it was obvious that not all members of her school community were comfortable or honest with each other, and some of the members perhaps exhibited uncaring and hardhearted traits with one another. As a result, Lindsey too was afraid that one of her colleagues may belittle or scorn her with criticism, and thus, she was reluctant to participate in the coaching model altogether.

I asked Lindsey if perhaps Teacher Coaching model would be more successful at her school if the expert-leader was not a peer-teacher from her building but instead a university faculty or a teacher educator. Lindsey replied:

I almost think that would be worse, because I think it would feel intimidating to begin with. I think it's because we have this feeling that all math professors think that Jr. High teachers don't know what they're doing - so we'd be feeling that way the whole time. So anything they would say, I would think we'd take wrong, because I just feel like it would naturally be built-in already, that way.

Lindsey's response to my question was enlightening. All of a sudden she changed her language, using the word "we" in reference to her school community as a whole and using "they" in reference to the university faculty. Lindsey now spoke about two community groups: her school community, which she largely represented, and the community of the university faculty, who (in her eyes) looked down on Lindsey and her school community.

Furthermore, teachers' resistance towards Teacher Coaching at times made it difficult for the coaches to carry out and fulfill their duties as well. For example, a middle school coach revealed that she was unable to implement this professional development due to the reluctance she received from four (out of six) teachers in her building. Additionally, the four teachers, who were reluctant towards this professional development model, filed false allegations to the principal about this coach:

> You know, just when I feel like things are beginning to go in the right direction, crazy stuff comes up. The most recent one was that somebody shared with my principal, I just heard this on Friday, that I was doing a research project where I was going to help two of the teachers and not help the other four and see what the differences were. So evidently there's some perception that I'm helping or being a part of two classrooms more than the other four classrooms. So that kind of stuff comes up and you go, 'Where does this come from?' But it's also a reality check, you know. 'Where am I spending my time?' Really, one day to move forward I find as a coach that I tend to go where I feel more comfortable, more accepted, so that would be in these other two classrooms because I know they want me there. The other ones I don't feel that yet. I mean, I don't feel that they mind that I'm in there but I don't really feel any acceptance of it or an energy that comes from it. So, it makes a difference (Mary Lou).

From these conversations it was apparent that both teacher perceptions about the effectiveness of the professional development and the teacher community involved in that particular professional development played a critical role in making the learning process possible, successful, and effective. The structure and the organization of the professional development greatly affected the effectiveness and final outcomes of teacher learning. But most of all, the teacher community and their perceptions about what constitutes "good" professional learning played an important role in making the learning possible and achieving professional development outcomes.

Overall, teachers suggested that for the coaching model of to be truly effective in their community, it must include several essential features. First and foremost, the

teachers must have a supportive and collegial relationship with the coaches, not

perceiving the coaches as expert-authority trying to tutor the amateur-teachers. Second,

the teachers have to trust the judgments and decisions of their coaches and be willing to

cooperate gullibly and candidly. Last, the coaches must be confident and have trust in the

teachers they are coaching. The coaches must also be instructive and educational, yet at

the same time be tactful, respectful, and considerate when providing feedback to the

teachers. Without these essential features the teacher-coaching model seemed to be

problematic, especially for teacher learning and professional relationship.

In summary, Shulman & Shulman (2004) described *community-centered* teacher

learning as - teachers engaged in developing the images of shared vision, or community

commitments, or shared knowledge base, or communities of practice through agreed

rituals (or ceremonies) of joint reflection and review that enhanced (or hindered) teacher

learning. From teacher data, it is evident that building a stronger teacher learning

community was extremely critical and necessary to ensure teacher professional learning

as a community.

Opportunities to learn in a community setting. The most talked about need, as a

community, was an opportunity to collaborate and work with other teachers and have

more opportunities to learn from each other - together as a larger group. Pansy, a veteran

teacher, summed up this subsection echoing many teachers' concerns related to

community learning and what exactly they wanted to learn:

> Just to talk. You know? We really don't plan much of our own professional
> development. We just kind of get told, here you do this on this day. I think that's
> the most important thing, Like the study groups or teacher discussion groups, I
> would love to do more of those. I'm in a couple right now. We have "teachers as
> learners", where we're reading general classroom management type things and
> talking about some of the stuff that's out there. I would love to do more of that. I

would love to do the classroom stuff, the classroom observation stuff, the classroom visits- I think that would be so wonderful.

Half of the experienced teachers also stated that they wanted to do classroom observations and have opportunities to collaborate, but they strongly suggested (as did Pansy) that those opportunities must be built into their contract hours. A few veteran teachers actually voiced that in their entire teaching career these opportunities have been scarce.

> Well, the one that I rated the lowest was 'I'm given time to work with other teachers as part of my professional development' and I guess I was looking at the whole picture, because I've been teaching for 22 years. I would say that one, overall, is the one I've been given the least amount of opportunity to do, is to work with other teachers. I think that while we all process information, some of us reflect, and I think I am a pretty good person with reflection, but I just recently learned that you really don't do a lot of processing unless you do that with someone else, or unless you do that with interacting with a reading or something. It's not just thinking driving to work is not necessarily going to get you anywhere, because most of us have our own already preconceived ideas, so it is hard to get us off that track unless someone else is there to talk to us and to throw some of those ideas out, so I think that's why that's important (Mary)

When talking about collaborating with other teachers, several teachers had specific ideas about how they envisioned doing so. Half of the experienced teachers mentioned the need for classroom visits and being able to discuss and consult with other teachers about classroom practice.

> I always think it's nice to have as many different people you can come in and watch you just because you get lots of ideas. Our district tried to do something; they called them professional development classrooms, where they picked one teacher from different subject areas for different levels, like one high school math teacher, and one high school science teacher and this or that. It was set up where you could apply for a half day sub or a full day sub and you go and watch a teacher's classroom for a day or hour or whatever (Doug).

Larry, a veteran teacher indicated that he did not have much opportunities or contract time to visit other teachers' classrooms, however he also mentioned that he enjoyed those

learning opportunities and that classroom visits to observe other teachers "pumped him

up":

> We have enough things that we have tagged on to us. Right now I don't have a conference period, so I couldn't observe someone now if I wanted to. I'm teaching 6 hours and I have supervision, I'd be willing to give up my cafeteria supervision to go watch somebody teach, but there's nobody else to do the supervision in the lunchroom. That would be ideal, I'm not at all uncomfortable having someone watch you up here, there's' nothing like that to make sure you're on your toes, I feel like I'm on my toes all the time, but if I'm sitting in the back watching someone, I can say, yeah I like that, or I wouldn't do it that way, or I don't agree with that. You can say all of those things, but when you're only teaching, you don't have a much time to reflect on what happened that day, sort of filming your every day and you couldn't possibly watch 6 hours of film either. But I think watching each other, it pumps you up.

Reflection was mentioned by many teachers, both novice and experienced. Reflection

was especially mentioned as a great need and an opportunity that teachers normally did

not have. Lena mentioned that it would be ideal to have an opportunity to reflect every

morning, even if it was once a week:

> I would like every Wednesday morning for the kids not to come until 9:00. So I get an hour every Wednesday morning before they get here as opposed to me staying after school every Tuesday afternoon. I don't think any of us feel like we have time to reflect on anything. There's just too much. You give a test and you're looking at it and you're trying to figure out, "why did they do so poorly on this? How should I do that differently next year?" but you can't because you're starting chapter five and you don't even know what you're doing tomorrow. I think there is some merit from the professional development part of it to a year round school. You know you go to school for six to eight weeks, whatever it is, and then you take two weeks off. But maybe teachers don't get two weeks off; they get a week and a half off. And you actually work a couple of days to reflect back on what you just finished up.

Amber, a high school teacher and a department chair, also talked about opportunity to

have teacher-time, so that teachers are able to spend time reflecting, grading, preparing,

or even simply taking a break. She also mentioned that teacher-coaching was something

was wanted to try as a learning opportunity:

It varies by teacher and it varies by course that's being taught, but kids just hound us to death; they are always here. It happens a little more with the upper level stuff; integrated 3 honors, integrated 4 honors, calculus. And a whole lot of it too is the personality of the teacher; are they a fun place to be for kids, are they inviting for kids. That makes a difference too. But there are a handful of teachers in this hallway that are never alone. There are always kids around, so that makes it hard to be reflective. Because when you do get a minute you've got things you've got to take care of rather than reflecting. Another thing, like "coaching by a teacher-leader" - none or very, very little of that I have experienced. You know, I've been observed and I've been evaluated but as far as having any instructional coaching, I don't really feel like I have. We have done things too where we we're required to be in somebody else's classroom. We've tried to make it very non-evaluative so the people wouldn't be fretting about someone being in their room.

A teacher-mentor have shared that she wanted to do more classroom visits, both evaluative and non-evaluative, however to be able to do so she needed time, which was a major constraint:

I think what would be helpful is if I got to observe other teachers that were doing a good job, or people think they're doing a good job. Or even if they weren't, just evaluating what was good and what was bad. But the problem is, we never have time to do that. We know it's good, and even when I'm mentoring other teachers, I barely have time to get in there and watch them (Kim).

In relationship to classroom visits, teachers also wanted to have more opportunities for "study groups". Teachers shared that some of these opportunities were already in place in several schools but they were related to general pedagogy. Teachers suggested that they wanted to learn in "study groups" to specifically tackle mathematics content and discuss the mathematics courses they were teaching:

Probably the study group where it would be visiting each others' classrooms and really having that reflection time on trying something new, and that could be combined with that technology idea. And then also I would enjoy any time that a mathematician would come and delve into the math a little bit deeper. Those are the things I listed for what I would need or want. Like for example our "Smart Goals". We probably did not understand quite what was going on at first so we had a slow start but now we are on board. And it would be easier to do too if we were in the same course. We could pick something very, very particular. Do a pre- post- test or whatever it may be. I ranked it a little bit lower, because even

though we are on that Smart Goal, I still do not think we don't have enough time to just reflect (Lena)

Similarly, Nadia, another experienced teacher indicated that she enjoyed watching videos and discussing classroom situations as a form of professional development, but she really needs to have more time and opportunities to be able to collaborate and work with other teachers:

There were some good videos out there that we did. That was really early, probably 5 or 6 years ago. They would take the class and say, "Here's a normal classroom situation and here's what you could do instead." Those were pretty helpful. I'm not sure everyone looked at them in the same spirit. I would really love to have more time to work with the other teachers in the building though.

From the above responses, and many other teacher responses, it was apparent that the teachers wished to build a stronger community of learners to attack the issues of mathematics content knowledge, classroom practice and teaching, curricular issues, and pedagogy. Similar to the ideas teachers provided on the topics they would like to learn as a community, they also provided some insights on how they would like to do so, and offered specific suggestions on what would work best for them in terms of learning together as a community.

Many teacher responses also indicated that they were open to the idea of learning from mathematicians, mathematics educators, and other professionals. However, most of these responses strongly indicate that teachers placed a greater emphasis on learning from their own colleagues, because they believed that classroom teachers knew firsthand and knew best about classroom instruction. Perhaps teachers' responses also indicate that teachers are more comfortable learning from other teachers because they can relate to their daily undertakings better in comparison to college professors, industry professionals, and district administrators.

Learning Needs of Teachers at the Policy Level

> *Finding learning opportunities outside the district.* Another teacher concern

surfaced from the interviews related to finding the learning opportunities. However this

concern was mostly raised by teachers with fewer years of experience. Teachers indicated

not being aware of the sources or information about available professional development

opportunities outside of the district. Many teachers mentioned that the district typically

announced district-sponsored professional development; however if the teacher was not

satisfied with the district's list or wanted to seek and attend other learning opportunities,

s/he did not know where to look to find them nor was informed about any search engines

that teachers can use to seek additional (outside the district) professional development

opportunities:

> I think sometimes I don't always find out what's out there. There's the standard
> first weekend in December one, the math council thing here, but other than that,
> other than going to Michigan or whatever when they had the Connected Math
> ones, I don't know too many. But maybe that's me, maybe I'm just not as
> observant at figuring out how to find that out (Mike, novice middle school
> teacher)

Mike was not the only one (as she may think) not to know about professional

development opportunities available outside of the district. Seven (out of 12) novice

teachers pointed out not knowing or not being aware of the resources where they can find

teacher learning opportunities. For example Mindy, a second year teacher, despite not

being an admirer of the conferences, explained that she did not know where to look for

professional development that she was interested or wanted to attend:

> I don't know where to go to look to find the conference, and my problem is, I led
> conferences on classroom discourse and on asking questions, but I still think that
> there's more I could learn, and so, I don't just want to go to a conference. I want
> to talk to someone who I know is in the profession who does it well and I want to

learn about the kinds of things that they do. I think a lot of times when you go to conferences you hear about the lower end, and I find that I'm well beyond what the conference is teaching too, which I feel is kind of a waste of my time and of the district money.

Mindy attended several conferences and did not find them helpful because she felt those were "below" her level of knowledge. I asked her what she meant by "below" and Mindy explained that as a fellow in a master's program for mathematics education, she was exposed to much of the literature and pedagogical ideas that are currently being presented at the conferences. Thus, she did not feel as if the conferences provided her with new information or instructional ideas to take back to her classroom.

However, Mindy had specific topics in mind, which she wanted to learn about; however, she expressed the need to know more about sources and ways that can be used to find professional development opportunities. Kira, another middle school novice teacher, also had similar troubles not knowing where to look for professional development opportunities:

I know there are websites that the Connected Math has, you can get on there. Different websites for help, teacher help, parent help, and ideas for that. Resources and stuff too, so we can use that. And see, I don't do as many conferences. I did that lower because I do the after school study teams, or I do the collaboration stuff, or I do the committee stuff if I'm interested. The Assessment for Learning, I requested that.

Kira too was not particularly a fan of the conferences, she preferred to stay after school and engage in teacher community learning within her building. Thus, she did not talk much about sources to find additional conferences; however she mentioned learning about available sources such as Connected Mathematics Project webpage, where teachers can find instructional ideas, even suggestions to help students and parents with the curriculum.

After noticing the pattern of novice teachers' responses about not being aware of the sources for available professional development opportunities, I asked a few experienced teachers (who were identified as high attendees of professional development) about ways and strategies they used to find additional professional development opportunities.

These experienced teachers shared that they used different ways to find outside-of-district professional development; however all of these ways had one key aspect in common – teacher networking. Teachers referenced being invited to attend and at times even to lead professional developments, by their friends and colleagues outside of the district. Many teachers also mentioned networking with other teachers they came to know while attending outside the district professional development. Nonetheless, most of the teachers referred to a "word of mouth" process that allowed them to share information about professional development availability with each other:

> Word of mouth pretty much, and what's interesting is, you go to those conferences and then you start talking with somebody and say, "Oh, you've got to check this out now," and, "Oh, you need help with this? Well, you go do this one," and so I really feel like it's hearing from other teachers, and then I feel like when you say, "This is a really good one," to another teacher they come back with you, "Well, you should try this one," and so I feel like the more you share, the more you get back on ideas of where to go (Audrey).

Audrey was identified as a high attendant of the professional development by the district. As she stated in her response the more she attended professional development (including outside the district) the larger grew her network of teachers. She also suggested that the larger grew her teacher network the better were the advices she got from them about the quality of some of the professional development and even got suggestions about the ones that were "good" to attend.

Elizabeth, a middle school veteran teacher (also a mathematics coach) shared that her process was also a "word of mouth" and networking:

> I guess it's just because I've been around so long I just know things, or people that I talk to, "Did you hear about this? Did you hear about that? Oh, there's this going on." It's a lot more word-of-mouth just because of that, than I actually seek something out. I don't anymore, very often, seek something out because there are just so many things. I'm busy enough as it is, so besides maybe seeking out national conferences or stuff like that I don't look for other things.

Elizabeth also revealed the fact that the only way she learned about outside of the district professional development was from building a strong network of teachers (outside of the district) over the years, and keeping in touch with them about what is available in professional development. She also shared that once in a while she would get a flyer or an email from another teacher informing her about some workshop or a session. She mentioned however that as her career years progressed she participated in fewer projects outside the district, including leading professional development sessions. However, Elizabeth also stated that as her career progressed she took on more responsibility in addition to her teaching load, such as becoming a mathematics coach and a teacher-leader, which she indicated kept her from traveling much.

Acknowledging teachers' recommendations and addressing their needs. The majority of teachers (25 out of 32) indicated that their "voices" not being heard by the district. One example was Mike, a novice school teacher, mentioned approaching his principal about implementing a new professional development program called "Assessment for Learning" (launched by the district) to possibly help the teachers in the building deepen their understanding and implementation of the program:

> P: I suggested to my principal that anyone that wants to deepen their understanding of assessment for learning they can come into my class; they can see what I do.
> I: And?

P: I'm not sure that's a priority. See, I think professional development doesn't always have to come from the board office or the administrator or the curriculum coordinator and again we do this sometimes, but I'd like to improve just teacher led professional development. I think promoting that climate of trust that we believe that you know how to teach best. That does well for people psyche, "We believe in you, we want you to implement this. We like what you're doing can we share this with other people?" I think you get better responses peer to peer than you do from different levels or different levels in the hierarchy.

Mike shed light on an issue that involved teachers' motivation to invest their time and energy into collaborating and working with other teachers, offering help and support to each other's, opening their classroom doors, or even willing to lead a professional development.

Teachers explained that they see several aspects needing to change to improve teacher learning, and one of them is acknowledging teachers' opinions and recommendations. Teachers suggested that for example, the format of district-sponsored professional development needs to be changed to ensure teacher professional growth, modifying the purposes and goals of some of the professional development opportunities in the district, especially addressing teachers' professional and learning needs. Olivia, a middle school teacher, with over ten years of experience, talked about teacher voices not being heard by the district:

Teachers need a voice. That teachers need to be asked, their needs need to be addressed and it needs to be done in a way that they feel comfortable doing. Teachers need to be provided time during the school day that doesn't take away from student learning to collaborate and to improve their teaching.

Olivia mentioned the need for the district to work on embedding professional development into teachers' workdays and focus on teachers' professional needs. Similarly, Danny, a first year teacher, also talked about not being heard, especially in

regards to his professional needs. He emphasized that his needs are different than other

teachers in the district who has been teaching for some time, even a couple of years:

> I guess ask teachers what they want to work on for professional development and do your absolute best to individualize it to each teacher because every teacher's needs are different. I think that's it. The difference between a first year teacher and a third year teacher, sure it's only two years, but the difference is huge. First year teachers need more time for planning, need more help with planning and management and things like that. Third year teachers, they've kind of got that stuff down, they need help on making things better, and first year teachers need help on making stuff better too, but my priority, whenever I'm at work working on lesson plans, it's usually not, "Oh, how can I make this even better?" it's like, "I just need to get this done."

Denny talked about individualizing professional development to teachers' needs,

depending on their experiences and years of teaching. He suggested that for novice

teachers the priorities are mainly to develop lessons and ensure the teaching of those

lessons. Thus, attending professional development on improving lessons he had not

taught yet was not as beneficial to him; however spending time planning those lessons,

would have been beneficial.

Carter, another teacher, who taught for two years, also talked about teacher needs

to be the focus of district-sponsored professional development; however his focus was

targeted towards building teacher communities and allowing for teacher-collaborations:

> The professional development should come from those who are professionally developing. It shouldn't be something forced upon you, it should be collaborative, and you should be involved. It should come from the teachers. Let's not spend five hours talking about something that maybe we don't think is even important. Try to figure out what we need first.

Carter, even though a novice teacher, already had developed a strong belief about district-

sponsored professional development and especially about the types of experts, who were

to lead and organize professional development. Twelve (out of 32) teachers talked about

best professional developments being organized by the classroom teachers. However,

amongst them there were also teachers, who talked about learning a great deal from working with university professors, administrators, leaders, speakers, or district professional development representatives.

Resources for teacher learning. Another issue brought up by the teachers was related to the resources (mainly financial) provided by the district for teacher professional development. For example, one of the department chairs talked about lack of monetary resources and literature resources for teachers to use:

> I think in order for it to have any meaning we would need more; we don't have the resources to be able to make it happen. We don't have the money or the time to go off to conferences that we find. So if I sit down at the beginning of the year and talk about wanting to find a way to help my students write and be able to include student engagement, that's fine I could pick conferences or speaker that I see or read articles but I don't have money to pay all the registrations fees (Elizabeth)

Another teacher talked about monetary support from the district to be able to seek outside of district-sponsored professional development opportunities and to be able to pay for substitute teachers:

> The outside P.D. opportunities are not there a lot. It's one of those things where they're not going to stop you but everything they tell us is - the money is not there for support. It's kind of sad. And ultimately every P.D. I've ever heard of has a registration fee, it's not horribly expensive but it's not cheap and plus if it's during the week you have to pay a sub so you can personal days or sick days. But they just don't have the money there to do that kind of stuff (Arianna, middle school teacher)

Financial support for teacher professional development was a "hot topic" mentioned by teachers. However, the responses differed. Some teachers mentioned that even though the budget was scant, they have never been turned down by the district to go to a professional development:

> I've never been turned down if I say I want to go to this conference or whatever. I probably should rank that as five, because I have never had any problem with that.

I have always received any support, money-wise or getting a sub or anything like that. (Grace, high school teacher)

Grace shared being always fully supported by the district in regards to her participation or attendance of any professional development opportunities she desired. In fact, she talked about the district providing not only financial support but also hiring a substitute teacher to cover her teaching duties during her absence. On the contrary, the following excerpt was also from an experienced teacher, who has been working in this district for almost ten years:

> It's very inconsistent. The district has a certain amount of money that they set aside for professional development. Then someone will come up with a great idea that would be great for everyone to have, and so what they'll do is put their whole budget into that. So we may do is reading in the content areas. So everybody's doing reading in the content areas and that may be not what I need or what I want. "But this is a good idea for everybody" - that's where we get treated like children instead of professionals. As a professional, if I'm having trouble with motivation, I think I need to do some work on motivation. If I feel like I'm very strong in content, then maybe I don't need that. So then in those cases if there's a workshop that I feel I really need, or want, or am very interested in, then there's no money for that. Now sometimes there's not only no money, but I can't even go on my own because I would have to take a release day or maybe I don't have any release days, maybe my kids have been sick or I've had to have a day off to do something else, when you only get 1 or 3 a year. So, unless I want to give up 185th of my salary, for the day, and pay for the sub and so forth and so on, and pay for the PD, then I can't go (Mary).

Mary's response was nearly the opposite of Grace's response - yet her response was one of the most consistent among the majority of teachers, who voiced their concern about lack of financial funds for teacher professional development. Teachers also seemed to be frustrated with vagueness of the matter, especially not knowing how much money exactly the teachers were allowed to spend on professional development, and most of all, concerns about inconsiderate and unwise ways the district typically spent the funds sponsoring professional development that were not addressing teachers' needs.

For example, many teachers complained that the district does not allocate funds for teachers to use for addressing their own individual professional needs, specific to the teachers' topics or interest and concerns. A few teachers referred to cases when the district only allocated funds for substitute teachers.

For example, Mary Lou, a veteran middle school teacher, also a mathematics coach, mentioned that for the most part the district is encouraging teachers to participate in professional development opportunities, however if their choice lies outside of district-sponsored professional development the teachers are not provided much financial assistance:

> When you go to things that are outside, they may say, "Okay, you can go to those," but they only pay for some but they don't pay for your travel, they don't pay for your conference fees, for registration fees. They don't pay for any of that kind of stuff; there's not money available for that. If you need a sub, they would cover your sub days, but all the rest has to come out of your own pocket. Yeah, they want you to go do it, but they're not going to pay for you to go do it.

I asked several teachers about the district's support or at least partial support for engaging in learning opportunities outside of the district. Many teachers agreed that the district does offer financial support of some sort; however the teachers described that the district's support was constantly decreasing, and the overall experience of applying for funds was becoming too wearisome and arduous to attempt.

Alexis, a junior high school veteran teacher, with over twenty-five years of experience, explained that in the past the district had been more supportive and wealthy in regards to resources, including monetary and professional development credit for teacher learning:

> I think money is the biggest issue. In the olden days, I would say 10 years ago, money floated a little more for Professional Development outside of the district. It doesn't as much anymore. Another thing that's really sad about it is that they - our

district in particular, who's always been very generous with Professional Development credit, stop granting credit too. I don't know what the rule is, it's a crazy rule, like if you go so many miles outside of the district, you have to have advance - two weeks advance notice of it to get credit for it. So we had a teacher last summer that went to this fabulous conference, it was on rating strategies, and she was an English teacher. She paid her own way, I mean paid like $300 to go to this conference because she thought it was a really good conference. So they didn't pay for it, but they also wouldn't even give her credit for attending it, because it wasn't approved two weeks prior to, and it was out of town.

Alexis expressed disappointment with the procedures and policies that the district adopted for financial approvals and teacher expense reimbursements for professional development trips. However, most of all, she was frustrated with the fact that teachers do not get rewarded in any way for putting time and effort to attend and engage in professional learning.

Elizabeth, a middle school veteran teacher (and a mathematics coach) described another concern that had emerged over the years and affected her teacher learning in the district. She mentioned that addressing teachers' individual learning needs was no longer a priority for the district. She clarified that the district is reallocating its money to support teacher learning communities, including small focus groups and learning teams, where a group of teachers in the same building get together to tackle or work on a specific common question/area that needs improvement:

We have some, but it's just discouraged to be spent on professional development money, I'm not going to conferences because I believe the way some conferences have been used in the past that's "one shot" kind of thing, so now most of our staff development is spent around our professional learning communities, study teams, whatever they're referred to. In our building, for example, that chunk of money that we get is divided up to our study teams. If you're on a study team, and maybe it's a literacy study team and there's the reading conference, if they want to spend some of their money to send one of their readers to that, they can. But as far as if somebody just comes up and goes, "You know, there's this gifted conference that I really want to go to," you're not going to have as high chance of getting funded because you're not attached to some study team that's saying this

is ok and we want to send this person back so they're going to come back and give us information. So that's changed through the years.

Alexis' response indicated that the district is refocusing its funds to support common learning goals and needs of teachers as a community, instead of each teacher's individual learning needs. In fact, this was one of the most talked about concern amongst the teachers, when discussing financial support from the district to address their own individual needs. A veteran teacher, with over twenty-five years of experience, also raised this concern:

> I think money, the problem with that is. Like for instance, if somebody wanted to improve their questioning, they wanted to figure out what are some good ways to ask questions, I want somebody to help me study how I question, how I can improve. I think that probably if somebody, one of their peers to track their questioning, sit in their classroom, they could probably read up on it, but I'm not sure that they would have the needs of being supported by the district to go to a conference on it (Payton)

These responses indicated that the district's funds and resources to support professional development was the integral part of making teacher learning possible. Moreover, district sponsoring professional development opportunities that are not focused on teacher needs and areas of concern (for development) was reflecting on teachers' motivation and attitudes towards learning and the district administration.

No time built-in to learn. Lack of contract hour for teachers to be able to collaborate and learn was another need that teachers expressed very specifically. Both experienced teachers and novice teachers described that their daily routines include a lot more than classroom teaching, and there is not enough time left at the end of the day for them to plan a lesson or grade, let alone time for building a community, getting together and learning. Teachers talked about not having enough time to fulfill the school and

district required responsibilities. Teachers talked about not having spare time to be able to

reflect on teaching, learn or meet with colleagues, read, or even enjoy their evenings.

Alexis, a veteran teacher commented on the workload of teachers being

excessively demanding. Her excerpt is a representative quote that was given my many

teachers about lack of time for professional learning:

> Teachers don't have enough time to do it. It's just really frightening to me the
> expectations that are set on every classroom teacher, and every single teacher is
> really working so hard to try to do what they think is best, so just doing the
> secretarial things involved with teaching is huge and it's really time consuming,
> but you're not getting to be a better teacher by doing those things. You're not
> given time to collaborate with your colleagues when you do those things. I'm
> doing the best I can, I'm teaching what I can teach, I do what I can do, but during
> that time, there isn't any time to get better at your profession because you're
> going to keep doing the same thing you've always been doing because that's the
> way you're used to it. I guess embedded professional development would be
> ideal.

Larry, a veteran teacher, complained that it had become extremely difficult to engage in a

meaningful reflection or be an effective teacher, while fulfilling school and district duties

that are extraneous and trivial for teacher development:

> Professional needs – to do my job more effectively we need to get out of [the
> math tutoring center]. We need to have pros in [the math tutoring center]. We
> need to hire teachers that stay in [the math tutoring center], so that we don't have
> to go down and teach six periods a day.

Novice teachers also complained. Kira's response shed on another issue she was facing

with lack of time. She mentioned the lack of time to work together and collaborate has

been affecting her school community and the relationship between the teachers. she

indicated that, because teachers are very busy, they typically isolate themselves in their

classrooms to be able to complete their daily responsibilities:

> I think that everybody is so busy that all of their intentions are good, I don't think
> that there's anybody that sits there and says 'I don't want to be a team player, I'm
> going to do my thing!'But you know, when you got teachers that are coaches, that

are parents, that are – you know, this sponsor and that sponsor and you've got a full plate in every aspect of the word, then something's gotta give. And I think that sometimes it is that cohesiveness among the peers. I don't think it's intentional. But there's only so much time and so many hours in a day, and we've got to teach our kids. We have to feed our families (Kira).

Kira commented on the lack of cohesiveness between peer-colleagues, as a result of too many responsibilities, that is in the end affecting teacher learning and professional growth.

Thus, teachers expressed a critical need to having spare time (ideally during their contract hours) to participate and engage in professional learning, instead of fulfilling job duties that are not pertinent (and are hindrance) to their professional growth.

Teacher-leaders' needs. In addition to these teacher responses about their professional and learning needs, there was a special group of only experienced teachers, who talked about their professional needs shifting as a result of additional responsibilities they fulfill for their schools and the district as teacher-leaders. This group of teachers talked about other professional roles they carry on beyond being classroom teachers, such as: teacher-leader, mathematics coach, department chair, teacher educator, student-teacher mentor, or program coordinator. Some of these teachers actually carried on more than one of these roles in addition to their classroom teaching.

This group of teachers had separate (from other experienced teachers) professional learning needs related to policy. These teachers shared that they would like to see more professional development offered to them that can help understanding and executing these roles. Moreover, many of these teachers mentioned not feeling skilled enough to excel in these roles as well. For example, Aiden is an experienced teacher, who was also a mentor to a student teacher:

I always think it's nice to have as many different people you can come in and watch you just because you get lots of ideas. Part of my thinking is this is my first year with a student teacher and it's very interesting to kind of switch the role and being the teacher that talks to them about what they need to do better and that kind of stuff. In some ways I think once you've been teaching, at least for me, after teaching for a couple of years you fall into a rut and you try the same things and it's harder to try something different. It would be nice to have someone else come in and give some ideas like, "you might want to try this, you might want to improve here," because I'm sure there are things I'm doing poorly that I need to fix. That would be nice to have someone to do that.

Aiden talked about two roles that he is playing, one as a classroom teacher and another as a mentor for a student teacher. However, because of his own uncertainties and reservations about teaching, he believed his professional needs should include learning how to improve his own teaching, so that he can be more successful helping his student teacher.

Another example somewhat different from the Aiden was Mary. She originally began describing her professional needs as a classroom teacher, but continued the conversation describing her needs as a department chair and a mathematics coach instead:

As a teacher, probably looking at assessment more, at being able to use it in a much more deep way than I have been and helping other teachers. Seeing how they've been using it to impact their teaching. I think being a good coach for other teachers. I think that's the one area that I think I would like to grow in. I'm given time to work with other teachers as part of a professional development. I think that's the one area, I mean, I know we have one day every other week that we meet for an hour after school. That's not enough. It should be several times a week and it should be on a consistent basis. So instructional coaching. I think, particularly me being a department chair, that's a weakness for me. I'm able to work with other people coming in and observing me and evaluating me, but I feel like that's an area of weakness, as a professional, I have working with my fellow staff members. I feel like I haven't had as much training as I would like to have had to make them become better.

Mary's needs shifted during the conversation, from focusing on aspects of classroom teaching to helping other teachers as a coach and the department chair. Remarkably, this group of teachers also talked about their professional needs as a result of them feeling the

need to become "better" at these roles (as coaches, department chairs, or mentors of student-teachers) became more lasting. For example, Mary mentioned her desire to learn about helping other teachers as a department chair and a mathematics coach because she believed it is a "weakness" of hers.

Similarly, Elizabeth shared her agony as a mathematics coach and a need for professional development as well. Elizabeth specifically mentioned a need to learn how to measure her success and effectiveness as a coach:

> Well, I am a math coach, so I think I would like to interact with math coaches from different districts that have seen some success, because my job right now is really hard to measure. Am I doing any good? Am I making any difference? What exactly is my purpose? I'm enjoying it, but as a classroom teacher you have a list of things from A to Z every day that you need to accomplish, and at the end of the day you can check them off. You may not know that student achievement piece, but you know that you did this, this, this, and this, this, this. Some of it is secretarial, some of it is whatever. And now, in my job I'm thinking, "Ok, my goal today was to get into every teachers classroom. I did that, now what does that mean? Where do I go from here? What do I do next?" How do you know you're making a difference? How is this measurable?

Elizabeth was concerned about a possible incompetence and ineffectiveness in her mathematics coaching. Most of all she was concerned about not being able to help her staff of fellow-teachers. Her mind was not at ease (as she described) because she was not certain of her exact role, function, or responsibilities as a coach and she did not quite yet have a measure to gauge her effectiveness. Thus, she felt desperately needing professional development or a chance to interact with other math coaches. Similar to other teachers in this group, she too demonstrated a perceived incompetence (or efficacy) in instructional coaching that was driving her need to learn more. Elizabeth's worries and questions above, "Am I doing any good? Am I making any difference?" spoke directly about her efficacy.

212

Unlike Elizabeth, who mentioned not really knowing her purpose as a coach and

needing more professional development to become better at it, several mathematics

coaches did seem to feel more self-assured:

> My needs have changed this year because of the position I'm in and one of the
> things I'm finding I need right now is to figure out how to help teachers better
> when teachers don't see; so it's the teacher/leader piece. That piece where I was
> able to go to and here was another really good one that I did. Three years ago, our
> district sent a mathematics leadership team for training in Colorado with McCrell.
> It was a regional thing. There were teachers there from Kansas and Montana, and
> there were probably 120 of us or so there. It was about leadership in mathematics.
> Again we had K-15 there; it was a very wide range of people and administrators
> and coordinators. It was done through teaching strategies, so I got to see a lot of
> different strategies with that group and it was around leadership. Unfortunately at
> the time I wasn't in the place that I was the leader so that timeliness wasn't there;
> there's probably stuff in there that I'm using that I don't realize but if I was to go
> back and do it now it would really be more effective because that's where I am in
> my professional life now. So I still have the books down on my shelf, I could
> probably go back and read them but the chances of that are probably slim to none.
> I think that that piece has yet to be so timely and right now that's where I am.
> Along with fact that I now have time, because I don't have to worry about what
> I'm teaching today, tomorrow, the next day, is I have more time to think about
> student learning. So how do kids really learn; go back to that cognitive
> development of how do kids really learn mathematics? Like a lot of times
> elementary people know that much better than middle school or junior high
> people. I think they have a better grasp of that; how kids progress from one place
> to another. So that's a neat thing for me too to understand how kids learn and how
> do they get stuck someplace and how do we move them forward? So the whole
> cognitive piece would be real interesting to me at this point in my career (Mary
> Lou, middle school teacher)

Mary Lou spoke explicitly about her needs changing as she took on a role of a

mathematics coach. She also seemed more confident about coaching, referencing her past

experiences with teacher-leader professional developments. This particular teacher was

very specific, recalling ideas and research initiatives from her trainings from many years

ago. She shared that she decided to focus her coaching on aspects of students learning,

which she believed was an excellent and effective way to help the mathematics teachers

in her building. She also trusted that focusing on student learning would be a reliable measure of her coaching success.

As I continued to interview, many more teachers were confounded and uneasy about how they should go about coaching, yet a few others had definite ideas of what they wanted to do, including detailed work plans and research-based ideas that they were eager to try as coaching techniques.

This was also true when talking to the department chairs. I met with one of them, Alexis, following the "reflective practitioner" session she organized for the mathematics teachers in her department. I asked her for the reason of choosing the "reflective practitioner" topic in particular, and how this session was supposed to address her department's needs:

> Because without reflecting, I think assumptions can be made that are not necessarily fact-based. That particular reflection, my goal was to come up with a goal for us this year. What is a struggle that we all have in common that we can work on, come up with strategies to help overcome that struggle? So, in that particular reflection, I was looking for common ground that I could hopefully get teachers to buy in to, to want to make it a goal, something we could work on during those meetings versus just giving them information from the district. Because, so far, that is all our meetings have been and I am brand new at this. It is hard to get teachers to want to work on anything else, because they have got enough on their plates. They do not want to have to work on something else. It was my first attempt to try to find an issue that everybody was having, so maybe they would buy-in to working on that issue in a way that they did not feel was extra work or they were being asked to do something they did not feel would be helpful to them or their students.

Alexis was a novice in chairing a department. She was struggling to get her teachers to buy-in to her new role as a chair, in addition to building common departmental goals for teacher learning. Her goal in mind was improving mathematics teaching in her school. However, one of her struggles, in addition to being new to chairing a department, was her awareness (as a teacher herself) of teachers' demanding and hectic schedules and that (as

a chair) mandating or requiring them to learn on their own was not going to be effective nor productive.

It was evident that teachers' inexperience with some of these leadership roles attributed to their perception of incompetence or feeling inefficacious. Moreover, several teachers (such as Alexis, Elizabeth, Mary, and Aiden) felt inefficacious regarding a particular aspects or a task of the role, such as: getting the department teachers to be "reflective practitioners", or coaching teachers for assessment strategies. Elizabeth, for instance, was feeling inefficacious with regard to the overall role itself and the purpose of the role.

Furthermore, this group of experienced teachers, when asked to describe their needs, only focused on professional needs related to carrying out these roles, and spoke very little about their needs as mathematics teachers. For example, in this study, the sample of participants included a veteran classroom teacher (with over 30 years of experience), who in addition to his school teaching took on a role of an instructor of the content and methods courses (at the Master's level) at the nearby university. His name was Colin. His students were mostly prospective middle and high school mathematics teachers of both the regular and the alternative certification programs. As part of his university coursework, Colin was also assigned to observe student-teachers in their field classrooms as well. When asked about his professional needs, Colin too, mostly mentioned his role as a mathematics teacher educator:

> P: I put down I'd like to be able to support other teachers in the classroom without having to be in their classroom. I'd like to know how I could do that. I'd like to know what I have to know or be able to do to help other people in their classrooms even if I'm not in their classrooms. That's a very tricky sort of thing to do. If I'm observing someone and I could say, "Well, I think when you got to this point you made this decision, I think that you told me that didn't work very well

for you. So let's go back and see what decisions you made along the way and see what are the other alternatives, so that the next time, if you want to, you can make a different decision." But that's based on what I'm seeing in the classroom and what the teacher is telling me. So when I work with someone, one of my first questions is, how did it for you? And they'll go, well it went very well. And I'll think, gee half the kids were asleep. In other words, nobody was causing you a problem. So if there's a disconnect between what I think I'm seeing and what they think they're seeing, then that's a thing for discussion. But most teachers have a rough idea of what went really well, that most of the kids were involved, or that you know, there were 2 or 3 kids that caught on really easily and I called on them a lot, they got it, but I'm not sure anybody else did. Ok, so how could you find out? So that's something that I'd like to know about.

I: That's because you're working with preservice teachers right now.

P: And even the other teachers in my building. How can teacher A help teacher C, even though they haven't seen what teacher C is doing? I think there are some things that we have learned over the years, and as I watch people, especially in the math education department, I see people doing things that I'd like to be able to do that as well as they do. I see them doing professional development or workshops, or as they talk about their classes and things like that, I think, they seem to have a really good handle on that and I don't have that same good handle on that.

Once again, this veteran teacher talked about being a novice teacher educator, who was struggling with many aspects of being a teacher educator, including connecting research and practice, providing feedback on classroom teaching, encouraging teacher reflections, and making mathematics teacher education courses meaningful to students. The role of a teacher educator was new to him, thus the tasks and duties of this job were also untried. This teacher talked about watching faculty in the mathematics education department "doing things that [he] would like to be able to do as well as they do", which once more demonstrates that this teacher feels inefficacious as well about carrying out a job of mathematics educator. Moreover, that inefficaciousness was found to be his driving force for wanting to learn more. It became apparent that the roles teachers take on in the span of their professional careers influence their prioritization of professional needs and their motivation to learn (depending on how efficacious they feel) to be able to succeed implementing and performing these roles.

Assertions: What Did Mathematics Teachers Want to Learn?

Assertion 1: Both experienced and novice teachers had similar learning needs at the individual level of learning; however the nature of those learning needs and their descriptions were different depending on the years of teaching experience.

Every participant of this study was able to explicate his or her needs for professional learning. Moreover, when asked about what is it that teachers wanted to learn both experienced and novice teachers had similar learning needs. However, the nature of those needs and their descriptions were somewhat different for the experienced teachers. Experienced teachers responses were more content-specific, and largely reflected the contexts and policies of their schools and districts. Novice teacher responses on the other hand, were mostly broad reflecting on the general (not mathematics specific) principals of pedagogy.

Furthermore, within their learning needs teachers specifically mentioned: a) student learning and motivation; b) classroom management; c) assessment; d) curriculum; e) their beliefs about teaching and learning; f) technology; g) teaching; and h) mathematics and being able to explain mathematics. These eight categories were somewhat more extensive than the list of categories Shulman & Shulman (2004) proposed in the framework for *individual level* of teacher learning: a) classroom practice, b) vision about teaching, c) content knowledge, and d) motivation.

Assertion 2: Experienced teachers, more than novice teachers, wanted to engage in community learning with other teachers.

Teacher with more than five years of experience voiced a greater need to be able to work with other mathematics teachers, than their novice counterparts. In fact, being

able to learn and work together with other mathematics teachers was ranked as the number one need for teachers with more than five years of experience, whereas only a few novice teachers mentioned teacher collaboration being important part of their learning. Teachers also indicated that it has been almost impossible to engage in community learning due to unrealistic school and district duties and requirements assigned to the teachers. Teachers specifically mentioned not having opportunities for community learning due to: a) lack of common contract time to allow teachers to get together, collaborate, and share ideas, b) qualitatively different teacher learning needs, which may vary from novice to veteran teachers depending on their experience, and c) weak teacher community in general

Community level of learning was identified by Shulman and Shulman (2004) to describe teachers' learning as a development of common vision for teaching, communities of practice, social support and motivation, and shared mathematical content knowledge. Similarly, teachers referenced learning within a *community* as a need to reflect on teaching mathematics by visiting each other's classrooms, engaging in study groups, sharing ideas, and supporting each other in teaching and curricula implementation.

Assertion 3: When teachers undertake organizational or administrative responsibilities that extend beyond their classroom duties their professional needs expand to include learning at the policy level, as teacher leaders.

Experienced teachers, who were currently employed as teacher leaders, department chairs, mathematics coaches, student-teacher supervisors, mentors, or teacher educators expressed the need to learn professionally at the *policy level* (Shulman &

Shulman, 2004). In fact, these were the only teachers who mentioned learning within the *policy contexts* and wanting to learn (become better at) managing staff, teacher coaching, department chairing, and supervision and mentoring of novice- and student-teachers.

Assertion 4:Teachers with less teaching experience emphasized a greater need to have information and resources to find additional professional development opportunities (outside of the district).

Experienced teachers' responses indicated that teacher collaborations and networking, especially expanded beyond the district, created additional learning opportunities for the teachers, some in a form of outside the district professional development, or in a form of collaborations and sharing of ideas, flyers, emails, creating joint projects, and even peer-leadership for organizing and facilitating professional development on their own. However, novice teachers and teachers with less experience voiced a great need to have channels and search engines to help them locate additional learning opportunities.

How Did Mathematics Teachers Want to Learn?

In this section I report the findings from teachers' responses to a series of questions about their learning, learning environments, and ways teachers preferred to learn the most. Since teacher responses about themselves as learners are rather different from teacher descriptions of their favorite learning methods, I separated this section into two major themes: teachers as learners and teacher learning opportunities and processes.

Each of these themes section include subsections that specifically describe major patterns emerged from the data. Some subsections also include findings that were categories depending on common patterns or noticeable major differences within the teacher responses.

Teachers as Learners

I asked teachers to describe their learning and their learning environments, in the questionnaire and followed-up with additional questions to better understand teachers' rationales for their descriptions.

The majority of teachers were troubled by the questions asking them to describe their learning styles and asking them to describe specific features of learning that they favored. During the interview, many teachers paused before answering my questions about their learning styles and contexts. After the completion of the interviews I realized that it was quite difficult for many teachers to describe themselves as learners and describe their learning. Many could not portray what type of learning style they preferred either, nor were they able to illustrate the formats and settings that facilitated their learning. Many descriptions were too short (one sentence), or were broad and vague. A typical answer I got from most of the teachers was, "I learn best the way my students do".

Moreover, teachers continually referenced their newly adopted curricular materials and mentioned liking the way their students were learning mathematics by working in groups, solving problems, and collaborating. Several teachers, after pausing for a few seconds and not being able to recall specific learning example, referenced their past learning experiences as a child or a student.

After asking teachers to describe themselves as learners and not having much luck, I followed up with additional questions about teachers' preferences for learning in terms of individual learning, learning in a community, or both. I asked teachers, *Would you say you are an individual learner or a learner within a group?* The majority of teachers answered this question as "both", some indicated being fond of community learning, and a few selected *individual* learning. On the other hand, those teachers who identified themselves as individual learners however were unable to provide examples of individual learning. In fact, these teachers' examples always included a collaboration of some sort with other teachers; however the teachers did not consider those types of collaborations as learning.

Based on these observations I separated this section into three subsections: individual learners, community learners, and teachers of both individual and community learning.

Individual learners. Teachers, when asked to follow-up and describe what exactly they meant by individual style of learning, continued to discuss learning that involved other teachers. Also, most of the provided examples included working with each others, collaborating with mathematics teachers in their department or building, and colleague communications via email, phone, and quick chats in the hallways. For instance, Mary, a

veteran teacher (also a department chair) began describing her individual learning experience, which she related to her childhood, but in the end she changed the description to relate to her current teaching profession and revisited community learning:

> I went home every night I sat there and I struggled with the mathematics to make sense out of it before I started my assignments, because I really needed to know why did that work before I could do it. The place I decided I was going to teach was my geometry class in high school. I had a teacher that gave us assignments and told us to go home and do it before he ever talked about it in class. Everybody in the class would say Mary, just go home and learn how to do it and come back to class and teach us, and I did that a lot of times. I would go through and figure out ways of explaining it to my classmates. So, I guess I am an individual learner, but I prefer group learning too. I much prefer that, because – like, I get tunnel vision very easily, and it's a way for me to check what I'm doing to make sure that I'm seeing other avenues for approaching something.

Mary had trouble providing an example of individual learning from her present years as a teacher, but she went back to her childhood and brought to mind some memories of learning mathematics as a child. After describing these experiences she identified herself as an individual learner. However, she somehow, in the middle of her response change her answer and stated that she much preferred group learning, especially now as a teacher. She stated that as an individual learner she gets a "tunneled vision" about teaching and learning but teacher collaborations and sharing of ideas help her acquire other perspectives and gain a broader view.

Mary recognized that when it comes to learning mathematics – she perhaps was an individual learner, however, when the topic changed to learning about teaching, she right away stated that teacher collaborations, especially regarding different approaches to teaching, were invaluable. Mary talked about how these collaborations helped her in assessing her progress and gain new perspectives about teaching.

Analogous to Mary, other teachers' descriptions of individual learning also included community as a component of their learning. For example, Grace, an experienced middle school teacher, stated that she was more of an individual learner, however when probed further to describe exactly what she meant by individual learning, Grace said:

> Probably more of an individual, and I think it's because I'm kind of a perfectionist, so I'm kind of one of those people where when I get in a group I always kind of sit back and watch the group because I figure that what I'm contributing is probably not as good as what everybody else is. I just never feel like what I say is probably as good as anybody else, I listen to the other people's ideas, and I join in, but I have a tendency to kind of sit on the outside and kind of watch. It's really funny because a couple of years ago when Deb was a principal, we were at school improvement, and I hardly ever say anything at the meetings. I'll listen and every once in a while I'll say something, but I rarely say anything, and she laughed one day because she said, "It's really funny, because you rarely ever say anything, but when you do I know it's always going to be good because it's well thought-out," and I'm like, "Well, I really didn't see that," but it's because I've thought about it for a little while, what some other people were saying, and then try to put it together first.

Referencing an example of individual learning, Grace right from the beginning of her example was situated within a community of teachers - attending a meeting. She described her learning as sitting back and reflecting or dwelling upon the ideas discussed by the community (e.g., during meetings), which she perceived as individual learning. For Grace, the act of learning involved - her thinking and listening (and processing) of the information that was shared with her by the community; however the community, even though a component of her learning, was not part of the learning process itself.

Grace's response indicated that teachers may have different definitions or perceptions of learning (whether it is individual or community), and perhaps teachers' definitions of learning are also different from the definitions in the research literature.

This pattern of teachers' responses and descriptions (of individual learning) continued. Teachers in the process of attempting to give more details about their individual learning had community as a component in most of their descriptions. Danny, a novice high school teacher, described his individual learning as:

P: I'd say individual. Usually when somebody gives me an idea or something to work with and then I try it on my own and kind of find out what I like and what I don't like and what I do and don't understand, and then I get together with a group of people and talk about it, and just hear other people's ideas, like, "Oh, I tried this and it didn't work very well. Oh, let me try that, that looks good," because I was having this problem and whatever they tried is similar to what I tried but I think whatever they're doing might solve the problem.

I: So you do collaborate with others or maybe a group of other teachers?

P: Not really. More on my own. I don't usually work with a group unless I have problems and then I'll say, "Hey, I can't get this. Help me out," but then once they're like, "Oh, try this," I'm like, "Ok," and I go back on my own and I just do it.

Danny began his description of individual learning by talking about spending time collaborating with others, sharing ideas about teaching and strategy that were "good" to use in his classroom. However, even though the teacher community was a component and played an important part in his learning, Danny did not perceive the community to be part of the learning process. Danny stated that he was an individual learner because he (individually) took the time and effort to follow up and implement his colleagues' ideas into practice.

In fact, for many teachers in this category (of individual learners) the act of individual learning, whether it was learning a new idea, or a teaching strategy, involved teachers trying (or testing) an idea in their classrooms, regardless of the origins of these ideas and whether teacher collaboration was necessary to obtain those ideas. For instance, Patrick, a middle school teacher, reflected on his individual learning:

P: Definitely individual. Recently I did something on homework feedback. One girl said, "Well Mr. Clifford, you always try these things, you don't always teach it the same way and that's what I like." And I said "Well Brandy that's because I don't know what I want to do yet." I'm constantly trying new things and seeing which ones work. I think once I stop doing that, then I'm going to be doing everyone an injustice. I think it's just constantly trying new things.

I: How do you know or find these things?

P: I think the hands on while I'm just teaching. Student teaching is amazing as far as what you learn. I think that actually having your own class is way different. And then probably the collaboration with other teachers. Just kind of ask, ok where are you? How did you teach this? It's really just trial and error, is what's been most beneficial for me.

Patrick provided a description of teacher learning within his own classroom, where he learned from his own students, tried out new methods of teaching, fathomed and discovered some of successful teaching practices. Patrick also shared that he collaborated with his colleagues, and acquired some ideas from them. However, similar to other teachers in this category, Patrick also called that type of learning *individual*, because Patrick tried these ideas in his classroom and adapted them, tinkered with teaching, and experimented with different strategies all on his own - regardless whether if those strategies and ideas he learned came from collaborating with other teachers.

Similarly Carter, another novice teacher, also shared a comparable (to Danny) learning experience that happened in his classroom:

I: So, you said you're an individual learner. Give an example, would you?

P: Yea. What I'll do a lot of times is, we'll do the lesson for the day and it's like the investigation from the book, and I'll actually just type up an outline that follows along with the investigation, so that way it's kind of organized. If there's a problem that I think isn't so good or is kind of weird and I want the kids to skip it or if I want to rephrase it I'll just retype it and say, "Don't look at the one in the book, look at this one," and then I'll take those handouts and I'll grade them and look at them. A lot of times, another thing that I'll do is after we've gone over something, like I've just introduced a new topic, then the next day I'll give them a warm-up question that's exactly the same thing.

I: Oh ok. Where did you learn to do that?

P: I don't know, it just kind of makes sense. As far as typing up the handouts that follow the book, a lot of teachers at Fairview [High School] do it and I was like, "Oh, it's a good idea."

I: Did they share that with you, or did you ask or had conversations?

P: Just conversations and seeing students have the stuff. As far as the warm-ups, a lot of teachers do them. I don't know what they do them on, but I just hate doing them on things that are unrelated, and some teachers will do them every day, I only do them twice a week. If at the end of the day I feel like I'm not sure if the students got what I was talking about or not, then I'll give them a warm-up the next day. That way I can pick it up, it's just one problem, I can look at it real quick and be like, "Oh yeah."

I specifically asked Carter where he got the ideas of using "warm-ups" and "handouts" in his classroom, similar to Patrick; he too mentioned learning these ideas from his colleagues. Carter also considering himself as individual learner because, as he mentioned, he put the effort to try out these ideas in his classroom and learn how to adapt them for his students. Thus, for all teachers in this category (except Mary), "learning the ideas" and trying them out in their own classrooms was considered individual learning; however the sources for these ideas (such as collaborating with other teachers) was not considered to be part of their learning *process*.

Moreover, all of these teachers mentioned learning (or trying out ideas) in their own classrooms. This indicates that teachers perceived classroom learning as individual because it did not involve other teachers, only students, whom teachers did not consider part for the learning community. From these conversations several patterns related to teacher learning emerged: a) teachers perceived learning within their own classrooms as individual learning (not community learning) because they were alone (without other teachers) b) teachers did not perceive students to be part of their learning community, even though (in case of Patrick Clifford) students were the sources for learning or had direct impact (and involvement) in teachers' learning within their classroom doors; c)

even though teachers, in most cases, included examples of learning where the teacher community was present and was a component of learning, the teachers did not perceive community to be part of the learning *process*.

Furthermore, towards the end of my conversation with Patrick and Carter, both identified themselves as individual learners, I found out that both of them valued the community and collaborations with other teachers very much. In fact, both Patrick and Carter asserted that teacher collaborations were the most important aspects of their professional growth. The following excerpt is from my interview with Patrick:

I: So, for you, as a teacher, what are some of the most helpful things for your learning?

P: I'm a trial-and-error, so something preemptive before the fact is kind of hard to come up with. Me, I think what would have been the most helpful is if at the beginning of the year, we spent maybe a third of the amount of time we did in meetings that week before school, just get rid of 75% of those meetings, and then just have another teacher sit down with the teachers that are teaching the same classes and have them say, "Here's what I do in my class. The kids like this, they don't like this. Here's some things to watch out for." Just stuff like that, just sit down with somebody who actually teaches the class and have them say, "This is what I do, this is what works. I've tried this in the past and it didn't work." Kind of like what I was saying, trial-and-error is the best way for me and the only way to get preemptive trial-and-error is to look at somebody else's trial-and-error.

Patrick stated that for him collaboration with other teachers in the building was the most helpful, especially before the school started. He talked about being frustrated with the district-sponsored professional development, especially because (as a first year teacher) at the beginning of the year he had to attend too many district-sponsored professional developments, which ate into a lot of the time he desperately needed to prepare lessons and teaching plans. Most importantly, these professional developments also ate into the time and opportunity for Patrick to be able to collaborate with other teachers about instructional strategies and ideas related to teaching and learning.

Carter, similarly to Luke, also mentioned the importance of teacher community in his learning. In fact when I asked him: *What type of things do you, as a teacher, consider good for your learning?* He answered without hesitation – working and collaborating with other teachers:

> P: I think it's just that we all think we're teaching it ok, and then one teacher comes up with a way that you just can't believe you didn't think of it before. And that's really cool. I think it's just how often the other person makes it sound. You know, if they say, 'Well, I tried this and I saw the light bulbs go on, one student said this' - it's like the validation that makes it exciting.
> I: So, what type of things do you, as a teacher, consider good for your learning?
> P: For my learning? I think working with others.
> I: Other teachers?
> P: Yea, I think that's part of the collaboration. Because when you're explaining something to somebody, you're learning it again. So that, and then, like I said, it's really just not being given something right away.

Similar to Patrick and Carter, several other teachers talked about individual learning as a yearning to experiment with a particular instructional strategy, tool, or an idea in their own classroom. However, several of these teachers also mentioned that for experimenting or be willing to experiment in the classroom was extremely time consuming and required countless amounts of teacher attention and effort. However, many of these teachers indicated having a great deal of personal persuasion and encouragement to do so:

> I said, 'I just pick a topic and I try it'. That is the only way for me, just do it. I know there is so much new out there. You get a preview of what is out there, but unless you get something that says, 'Every year I am going to input this technology on this lesson' - it does not work for me (Michaela, high school teacher).

Michaela's response indicates that t engage in learning that requires to try new ideas and strategies, even if the teachers acquired them from collaborations with other colleagues, teachers needed a great deal of patience, motivation, and persuasion to stay concentrated and persistent adapting these ideas and strategies into their classroom environments.

Community learners. Thirty (out of 32) teachers described several of their favorite learning instances that occurred within a group of other teachers; many recalled specific examples of lesson studies, curricular discussions, book readings, even visiting each other's classrooms as part of their peer-learning. However not all of them identified themselves as community learners. Only eleven teachers (out of 32) indicated that they were community learners, and not individual learners or both. However, the answers of these eleven teachers were quite similar. Many of them stated that learning in a community setting provided them with opportunities to have meaningful conversations with other teachers about teaching mathematics. Teachers indicated that community learning allows them to learn new strategies and ideas from one another.

Amber, experienced teacher, recalled learning about her curriculum, student thinking and mathematics in a group setting. She not only enjoyed it but she explained that it was meaningful, especially the reflection part of community learning:

> I know that when I started learning this curriculum we did it in small groups, we did it through the Core Plus Grant that the University had is when I did my best learning, I think. We did work in groups and we talked about it. I don't know that I could learn and think about mathematics we ask kids to do today without being able to talk to somebody about it. Although when I was growing up, of course, I did it by myself like everybody else through practice. But it was the reflecting piece with other people that could see what I was doing. Then the learning that went with it because we talked about what good student discourse looked like. So we had learning piece with it, we had some reading that we did, it wasn't long and it wasn't heavy reading, just some reading to inform our thinking. Then the fact that, as a teacher when you reflect all you have is your reflections, you don't have anybody else's thinking on it. In order to get better at something you've got to have more information but you can't get that information without somebody else having input on you're doing. Very few teachers can read something, I think we can read it and go in and try to do it but I don't know if you have success or not until you let somebody else see what you're doing.

Amber engaged in a variety of professional development opportunities throughout her career. In fact she was identified as a high attendant of district-sponsored professional

development by the district coordinator. Moreover, every one of Amber's "best"

professional developments, she described, involved learning in a community settings,

especially if the reflection on practice and teaching was the core content of that learning.

Zane, another experienced teacher of almost ten years of experience, shared that

her choice for community learning was due to the fact that she believed it was the best

way to share pedagogical knowledge related to teaching mathematics and that community

knowledge is infinite:

> There always new things going on that you can always gain something from
> somebody else. Always, even if it's a strategy that somebody has tried in their
> classroom, and it works, and you've got a chance to share it and you're like, "Oh,
> wow, I'd like to try that." If you hadn't had gone somewhere and met with them,
> you would have never known that. You never would have had the opportunity to
> try something new, and I think you always kind of have to look for new stuff, or a
> variety of stuff. So, that's what I think, I think people don't realize that
> professional development really happens anytime you meet with a peer and talk
> about what they're doing, what you're doing, and bounce ideas off each other,
> because you're sharing something.

Similar to Zane and Amber, many other teachers in this category (community learners)

indicated that community learning was the most meaningful and supportive way for

teachers to grow together as a group.

Teachers of both individual and community learning. Fifteen (out of 32) teachers

identified themselves as learners f both individual and community learning. These

responses were also quite comparable and homogeneous. Teachers mostly described

learning as a hybrid method of learning that consists of both parts: opportunity for

individual thinking and pondering about a given idea or a problem and an opportunity for

gaining insights from other people (in a group) about the same problem or an idea.

For example, when interviewing Zane, she shared that when tackling any topics,

initially she needs time to think about the them on her own first. Then after she had a

chance to organize her thoughts she feels ready to share and contribute to the community

as a learner.

> I said a couple of things. I said that I liked to at first work on the topics myself. For me to figure out what is going on and kind of organize my thoughts. Then I like to turn and verbalize it to others and I do enjoy working with a team to tackle a problem. I have good memories of graduate school and math, and going through my math masters and working on something together.

Zane response was a representative example of many other teachers' responses to this

question. She additionally stated that she had good memories of using both individual and

community work while being in graduate school learning mathematics.

Another, very similar (to Zane) response was from Michelle, an experienced

teacher, who described his learning style as cognitive, involving processing variety of

information, however also including both individual and community learning:

> I put having material presented to me in a variety of ways and having time to think through and process what I'm learning. So I think I need both, because I think the group really helps me to think, but I also really need think time in the lead and think time at the end, because I have to put all that processing together. I don't like to be presented with the problem and immediately be thrown into a group. I like to be able to think through, "Well what is this question asking?" first, so I have a good idea of what the question is before I'm ready to have a conversation about it with others.

Michelle also reflected on his learning by explaining that he liked to initially absorb the

information before he is ready to share is thought with the community. These types of

responses were typical from most of the teachers in this category. However, the responses

in this section indicate that teachers have different styles and preferences for learning, but

mostly the predominant majority of teachers tend to value and favor learning within a

group of other teachers or the larger community. Teacher responses also indicate that

teachers define learning differently. Moreover, teachers also define the role of the

community in professional learning differently.

231

Effective and Ineffective Teacher Learning Opportunities

In this section I present the findings specifically related to the learning opportunities and learning processes that teachers experienced and identified as desirable and undesirable. To support their statements about these learning opportunities teachers provided examples and explanations, which I also included in this section. To mirror the framework I organized these findings into three subsections: a) individual level learning opportunities; b) community level learning opportunities, and c) district/policy level learning opportunities.

However, the major finding of this section lies in the fact that there were a few learning opportunities that the teachers did not agree upon in their ratings. For example, teachers spoke about the same exact professional development differently. Some commended the opportunity and the learning that occurred, whereas others criticized the same exact professional development entirely. I added these findings at the end, in the subsection: inconsistent learning opportunities.

Individual level learning opportunities. As I followed up with the teachers on their individual learning, I asked them to specifically give examples or descriptions to support their statements. In this subsection I only included teacher responses and descriptions that did not include or were not situated within a teacher community setting (for example unlike Grace, Patrick, and Carter).

A pattern emerged from these teacher responses. None of these teachers included learning opportunities inside their classrooms. For example, Mary described her individual learning as setting aside some time from her conference hour to be able to

walk around the hallways, observe, listen, and sneak quick looks into other teachers'

mathematics classrooms:

> As I walk around during my conference hour, I always slow down when I come past a classroom, and I'm like, 'Well what's going on in there?' And I was like, 'Well I should just stop in some time. These people use technology a lot. This person is really focusing on objectives and telling the students the objectives and having them self-assess', and things like that. So then I think: 'Maybe I should go learn about that, maybe I should go learn this technology'. Oh, are you talking about individually like reading a book?

Mary answered the question about individual learning by providing an example that

situated her learning outside of her classroom (school hallway). She talked about taking

initiative to find time (or make time) to walk around to learn from observing other

teachers' teach. One of the key aspects in these teachers' responses was reflecting back

on their own classrooms and teaching. Mary mentioned reflecting back on her teaching

while watching and comparing her peer-colleague teaching. She noticed different

instructional strategies and tools (such as technology) they used in their classrooms, and

she recognized the need for her to learn more about these strategies and tools to be able to

integrate them into her classrooms.

At the end of the excerpt, Mary asked me about "reading a book" as an individual

learning. My response to her question was "anything that she qualified as individual

learning". Mary mentioned that she liked to read but did not have much time to do so on

a regular basis. Similar to Mary, eight other teachers talked about reading professional

literature, articles, or even mathematics textbooks and instructional resources.

Kim, a veteran teacher, mentioned reading various different literature, even during her

time off in the summer:

> Well, that tends to be probably more reading I'd say. Maybe it's *Mathematics Teacher*; maybe it's a book on assessment or a book on engagement or a chapter

out of something. Sometimes it is in the summer when I'm thinking, "maybe I should work on some Algebra 2 and see if I can make it more investigative," and I go find a Discovering Algebra book. It's a very discovery approach and maybe a little watered down. But I will do some things like that in the summer time. Although sometimes in the school year I may do that but I'll go get another book or two or three and see how do they teach completing the square. So I'm pulling it out and looking at it and trying to come up with a better way of doing it. So I spend some time that way too.

Kim also mentioned setting aside some time (after school or even during her summer breaks) to engage in reading professional literature, evaluating the representations and mathematical topics illustrated in other textbooks, and reading research-based literature on students' learning and assessment. Kim also perceived individual learning as a process that takes place outside of her classroom, without her students, peers, or colleagues.

Susann, a novice high school teacher also talked about individual learning, especially in regard to reading professional literature. She mentioned the reading materials she is gathering while completing her undergraduate and graduate degrees:

In my undergrad and in my fellows program in my graduate classes we do a lot of reading journals and articles and reflecting on them. They're not all specifically mathematics related, but many of them are. Especially my mathematics methods course that was, with Fran, we had more articles and reading. Those were helpful. At the time I could see it would be helpful but I couldn't think of a way to actually apply it at that time. Now reading those types of articles I'll think about my class and my kids and it's much more relevant and beneficial.

However, even though readings professional literature was mentioned by many teachers, not all of the teachers were in favor of that learning process. Actually, more novice teachers (than experienced teachers) stated that reading professional literature was not as effective as other models of professional development. Novice teachers indicated that they would rather engage in conversations with other teachers, observe their classrooms, and share ideas about teaching instead of reading an article.

For example, Sidney a novice teacher, talked about reading as one of her least favorite ways to learn. She described reading as, "Not for me, personally. I'd rather do something or watch something being done, rather than just sit down and read it. It's too much like school, just sit down and read". In fact, many novice teachers, like Sidney, mentioned that reading reminded them of their recently graduated teacher education programs, and that most of the literature contained similar information they already read, thus reading articles was somewhat similar to reciting or reading about the same ideas repeatedly.

However, both novice and experienced teachers agreed that professional development in a format of a university course, mostly mirroring content and methods courses specifically designed for teachers, would be extremely helpful and that teachers enjoyed participating in more of those types of learning opportunities. Many teachers (20 out of 32) mentioned that they are in need to take more content and mathematics courses for teachers, even if those are presented as workshops, seminars, or college classes. Teachers even shared their stories of university classes they took, and provided specific descriptions of those experienced.

Lena, a veteran teacher, mentioned specific processes that she liked when taking a university course and features that helped her learn better:

> Some of my best professional development were classes that I took. I consider those professional development. You go back to the university and take a course on content or you take a course on methods or something like that.

Similarly, Michaela a high school teacher, also mentioned enjoying solving mathematics problems and tackling challenging ideas, which she remembered doing from her graduate degree in mathematics:

> I have good memories of graduate school and math, and going through my math masters and working on something together. I do enjoy working with a team to tackle a problem though. I said that I liked to at first work on the topics myself. For me to figure out what is going on and kind of organize my thoughts. Then I like to turn and verbalize it to others.

In conclusion, somewhat contradictory findings developed from teacher responses. Those teachers, who identified themselves as individual learners, only mentioned trying out ideas and strategies in their classrooms in regards to teacher individual learning process. However, teachers, who did not identify themselves as individual learners, but who were able to generate examples of teacher individual learning, did not include any that had instances of learning inside the classrooms (or during teaching).

Community-level learning opportunities. Examples and descriptions of community learning were numerous and different. Some teachers, who knew the terminology, referenced specific models of professional development (e.g., study groups). Others, simply described community learning that they found helpful and effective for their learning.

One of the predominant references in regards to community learning was opportunities to *sharing ideas* with other teachers. Some teachers were more specific in terms of the grade level, or curricular materials, others were indifferent towards those specifics, and simply express more need for opportunities to share ideas, regardless of teachers' grade levels or years of experience.

Jane, a novice teacher with only two years of experience, shared that the teacher collaborations and sharing of ideas is where she gets the most out of her professional learning. She also shared that teacher collaborations should not have to be pre-organized

or situated in specific setting - even a lunch break could be transformed into a peer-collaboration:

> Honestly, that's when I get the most out of it. A lot of times it's not even in that setting, it's during the lunch break, or out in the hall, when we finally can just talk and say "well I did this one time," "oh yeah, well I did this one time," "oh, well this didn't work," "well you can do this." To me, that has been where I get the most. A lot of times it's not about the speaker or the worksheet or whatever, that they've given it's just about talking with other teachers and talking about what worked for them and what didn't. That's been helpful. But I'm a second year teacher so, maybe along the way that won't be as beneficial.

This was Jane's first year at this particular district. She talked about one of the aspects of community learning that many other teachers mentioned: teacher support and willingness to participate in these collaborations. Jane had many unfortunate stories about her past experiences, especially from her previous district, where lack of collegial support impaired her learning as a teacher:

> This district is a lot better, I don't want to say overall it's a lot better, but my department is extremely different. We would have collaboration time at my old school. Every Wednesday morning was time for math teachers to meet before the students came. We would meet for like two minutes and say "okay, is there anything to be said? Well not really." Then we'd split up into our content areas. Then the teacher would go, "Do you have anything to say?" "No." "Do you have anything to say?" "Not really." "Okay, well I guess that's it then." That would be our collaboration every single Wednesday; and I'm not exaggerating. As a first year teacher I had a lot to say, I had a lot of questions about grading, about keys, no one gave me any materials to start off with, I didn't have a workbook, I was making up everything. There was no communication at all. It was almost like "Well you didn't send me anything." So I was making up and working so hard, I didn't want to send my stuff. Here it's so different because it's so give and take. Everyone here is so give and take. I'm shipping stuff out and I'm getting more in. It's like, you work hard but everyone else is too. There I just felt like I was out on my own island. The collaboration is awesome here.

Jane described that in her previous learning experiences teacher collaboration and openness was vital. Over the years, she found that teacher support and teacher assistance to each other had been extremely beneficial to her professional growth. The ability to

share materials, ideas, and resources enabled her to work hard and feel "good" and motivated about her job and learning about the job. She mentioned that "give-and-take" relationship with other teachers had been the foundation of her professional learning.

Ebony, mentioned needing to have curricular meetings, where teachers can discuss teaching specific units and help each other with instructional dilemmas. Ebony especially suggested the experienced teachers, especially the ones who experienced the curriculum and experienced teaching the integrated curriculum, to lead these types of meetings for novice teachers, such as Ebony:

> When they started this four to five years ago, integrated teachers were meeting once a week, once every couple of weeks, and say "Hey this is where I'm going with this." Or they were meeting at the start of every chapter and saying,. "Okay this is what I'm going to do with this, and these are the testing dates we want" And at [our school] right now, there's three teachers that are the main Integrated teachers, that have been doing it for four years. Which is fabulous. But I come in, and I'm supposed to teach one section of it, and they've already got it down. So they're not really talking about, I mean – they're not getting together with their planning meetings anymore. And district wide – maybe we're to a point now where we are not going to have so many new teachers in the school. But every year you're going to have at least four or five new people doing it. Like a monthly meeting or a chapter meeting, where you bring in the month of October – two people from [our school] that have done Integrated come in and talk to all of the new teachers – "Okay, this is where we were at last year" Because like my kids will ask me questions, and there are stuff that we're teaching integrated that I've never learned before.

Susann, another novice teacher who has been teaching for three years now, explained that she too had benefitted from learning by sharing the ideas with one of her colleagues in school. Her colleague taught the same classes, and was willing to meet with Susann on a regular basis for two years continuously, to discuss the teaching and learning episodes from both their classrooms. Susann specifically mentioned enjoying *study groups* and teacher discussion groups:

Study groups or teacher discussion groups - I said I've done over one hundred, but I've done them on my own. My co-Fellow, the year that I was a Fellow, he and I taught exactly the same courses and we got together once a week and for two years, even though we were only a Fellow for one year we continued it the next year, we planned every single day. We taught the same thing every single day, and teachers say it can't be done, but it was fantastic. Every week we got together, we looked at our problems, we talked about which ones were worthwhile, which ones we wanted to skip, which homework problems went directly with what we were teaching that day, how we were teaching it, why we were teaching it. We questioned each other, we argued. He's one of my best friends, so it was easy to talk to him and it was easy to argue with him because I knew that our hearts were in the right place.

Lesson study was another model of professional development that many teachers either described or specifically mentioned using terminology. Celeste mentioned wanting to try lesson study because she believed it would "really productive" for her learning and professional growth, especially in regards to the newly adopted curriculum:

Lesson study. I think that would be interesting, I've wanted to do that for a while. Which would require, the ones I've read about, they spent a lot of time preparing just one lesson, and thought about all the things the kids would respond, how they would respond, what good questions you could ask, what good problems should you use, and then evaluating how that worked out. I think that would be really productive, if we had time to do it, and that's one of our big issues is finding time to do something like that.

Classroom visits was another commonly mentioned model of professional development that teachers expressed great interest in doing. Aiden, a junior high school teacher and a department chair, shared that he valued classroom visits very much. He took advantage of the district's sponsored classroom visit opportunities when possible. He especially valued that after the observation he was able to talk to the teacher and ask questions, as well as provide feedback. However he mentioned that one aspect of classroom visits must be time, not only dedicated to teach the lessons, but for the observer-visitor to come-in to the classroom on a regular basis, to be able to offer a more in depth feedback and have more meaningful ongoing conversations:

It would have to be a fairly regular occurrence. If someone comes in September and watches one class period and tries to help me out, there's just not a whole lot of information you can get there. If you're going to do it you would have to either come in the same hour every day for a week or come in and watch the same class every Tuesday and watch them continuously. It has to be something that is a several day long process, not just a one hour block.

Overall teachers explained that the topmost desired and needed learning was community learning. More specifically, opportunities to connect and work with other teachers, support each other with advice, ideas, and recommendations, and, most of all, have opportunities to learn from each other by conversations, classroom visits, mentoring, curriculum and lesson planning, examining student work, and communicating (e.g., email, phone, etc). Novice teachers also mentioned that learning with and from their mentors have been especially helpful and useful to their professional development.

Policy-level learning opportunities. Teachers also provided numerous descriptions of the *district-organized or district-sponsored* professional development, most of which lead by either a district coordinator, or staff recruited by the district. However, these teacher descriptions were not as colorful, and sounded more dissatisfied with the overall quality of learning experience.

The majority (28 out of 32) of teachers responded that the district-sponsored professional development is mostly in a form of a *meeting* (in a district building), with somebody from the district presenting information to them, for the most part using a *lecture-style presentation* (or using a Power Point presentation). Many shared that typically district-sponsored professional development was related to policy, or evaluating policy documents (such as curricular frameworks), or analyzing district-wide data collected over a period of time, or discussing the issues related to district, state, or policy

requirements. Teachers stated that they did not find those professional development effective or valuable.

Twenty five (out of 32) teachers actually put down negative accounts, to share as descriptions, of district related professional development. Several (8 out of 32) teachers did not have a specific setting in mind; however, they too had similar concerns (as others) about the quality of the district-sponsored professional developments. For example, Vicky, a second year teacher had much to say about her unsatisfactory experiences with the district-sponsored professional development:

> I never really got a whole lot out of them to be honest with you. I mostly feel a lot of times, professional development is just saying that word "developing," but we're really not and it's kind of a waste of time. It's kind of like I feel about educational classes, I just feel we're just talking but not really getting anywhere. The idea is good but the presentations are not. Even as a second year teacher I never got anything out of it. I was a first year teacher so obviously. The idea's good but it's not truly beneficial to what we're trying to do. Teachers are smart people; I think they forget that sometimes. So it's like preaching to the choir you know? You need to be respectful of the students; well no kidding. You need to keep your class with different activities; well no kidding. It just kind of seems like they tell us the things that we already know; over and over.

Vicky's frustration with the repeated information was actually something other teachers mentioned as well. Doug, who has been teaching for almost ten years, also talked about attending professional development and being frustrated about not only hearing similar ideas being recycled, but the organizers and the presenters of the professional development not being credible to run the professional development and advise on some of the issues:

> P: Another thing about this is when I've gone to those...I've gone to professional development where they've talked about these things. It may be a reading teacher, and so she or he will gear their whole session on reading. That doesn't help me. I've had it where professors who haven't been in the classroom for years, go up and say, 'This is the new stuff, this is what you need to do', but they've never done it. That always bothered me.

I: So what was so bad about them?
P: It was the fact that they didn't realize that we'd heard the same stuff four times. It was becoming too boorish.

Ten (out of 32) teachers mentioned that on several occasions the content of the professional development was dull and somewhat repetitive, and that the professional development they attended often ended up focusing on the same ideas and recommendations. Experienced teachers explained that they heard the same ideas being advocated over and over again. Novice teachers too were not happy with learning same ideas again and again. Novice teachers explained that they already learned these ideas during their teacher education programs and that hearing them again and again was becoming uninteresting.

Another pattern emerged from the teachers responses, especially novice teachers, was related to teacher complains about the *districts-sponsored professional development*.

For example, Gavin, a novice teacher, who started his career just one year ago, spoke highly of the department meetings calling them helpful and fun; however, expressed disappointment with the district's professional development:

> Well usually, I guess in the district, it's kind of just, I think of the word 'meeting'. And I think of 'how long is the day going to be?' to be honest. But it is my first year with it. They're ok. I would say the new teacher in services were pretty informative. I guess everybody needs that. They were pretty well-rounded. Some of the information I don't think you can make too interesting you just kind of have to say it, especially with the size. Now some of the math stuff, some of it is good, some of it is pretty dry. So I haven't really gone to any professional development that I didn't have to. Mostly because of my coursework. And a lot of it is I don't like being talked at, and I feel that's what a lot of professional development is.

Gavin, besides expressing negative experiences with the formats of some of these professional development sessions, where the presenter "talked at" the teachers, also raised an issue of the size of the teacher population engaged in the district-sponsored

professional development. Logan indicated that he only attended mandatory professional development.

He continued to express his disappointment during the conversation. He was especially frustrated with the district spending a great deal of valuable teachers' time collecting various and numerous data and asking the teachers to work and analyze these data. Furthermore, he was infuriated that in the end, the teachers never "saw" any results or outcomes from these data:

> Well, we're usually not too motivated. Really, it does go back to, especially the teachers who have been here awhile, they see things where they want to start these projects and then they don't go through with them. It's not just professional development it's a lot of things. Everything is so data-driven and people want to collect data all the time, but then we don't do anything with the data. We just kind of look at it or we don't even look at it. Or we look at it and say 'this is the data' and then that's it. The quality too. It's hugely well-organized, they know what they want to do. I just kind of dread the days – I kind of feel like I'm not going to get much out of it (Gavin).

Indeed, twenty (out of 32) teachers, both novice and experienced, voiced frustrations with the same issue. All talked about collecting different types of district-wide data and spending numerous hours looking through and analyzing the data, which in the end either gets left aside, or does not generate any improvements and desirable outcomes in student achievement. Here is a response from a veteran teacher about several of such instances:

> Sometimes we've had ones where, ok, here's what I want you to do. I want you to think about your curriculum and I want you to come up with the big ideas in this unit, and then we do all this work, and then nothing happens with it. Those kinds of things are really frustrating. So why did we do that? And it's also that way kind of with the data collection. Ok, so we're doing all this CPAI, somebody is filling in all these bubble sheets, but what are we doing with it? When they have you doing something that we don't see any benefit from, those are the worst, because you think about, you're sitting there, you've spent two hours, and there's nothing that's come out of it that's going to help you in the classroom. Like, we spent a lot of time making up a survey that got sent to students, parents, faculty, etc. We never really got to see much of that. I know it's somewhere and we can go to it, but we never discussed it and said, "Here's where they rated us down,

243

and maybe we should do something to address this." So, sometimes we spend a lot of time doing things that we don't see any outcome from, and that's frustrating (Kim)

Kim, has been teaching for almost fifteen years and has been identified by the district as one of the high-attendee of the district-sponsored professional development opportunities. However, from her excerpt, it is evident that this teacher's attendance of professional development did not necessarily mean she enjoyed them all.

Inconsistent learning opportunities. A pattern emerged from data analysis related to teachers perceptions, likes, and dislikes about professional development, especially the same ones they attended. Teachers spoke very differently about the same professional development event. Some spoke in favor of the event, whereas others were by and large critical and disapproving of their experiences at the same event.

For example, the district arranged and sponsored continuing professional development sessions, during which teachers had a chance to get together and discuss the implementation and use of the newly adopted curriculum materials for *Connected Mathematics Project.* These professional development sessions were held once a month on a Saturday morning (average three hours), teacher participation was voluntary, however, if participated, each teacher was compensated for their time in the form of monetary stipends or inservice credit. The sessions were originally organized for the teachers to examine the newly adopted *Connected Mathematics Project* (CMP) curricular materials, and analyze the alignment of these materials to the state curricular frameworks, create potential assessment samples to document student learning, and discuss the overall implementation of these materials in the middle school classrooms. The structure of these sessions mostly included two phases: the whole group discussions (typically at the

beginning of each session) and the breakout sessions (after the whole group discussions) for teachers to have the opportunity to branch off into smaller groups and discuss curricular adoption and implementation process in their classrooms.

Many teachers participated regularly in these sessions and most of them spoke highly of these sessions. For example, Mary, a veteran teacher, remembered excitement and positive overall learning experiences during these Saturdays:

> Those Saturday breakout sessions made a huge difference, even though towards the end, not a lot of people were coming. I still think that for the majority of people they changed the way we were teaching. It was no longer us standing in front of the room pontificating to kids, it was more directed questioning, leading somewhere for the kids to discover it themselves. I thought it was all pretty useful. I think in the beginning, in the very beginning, I'm not sure that Fran and Chip had any better of an idea of how to go about this than the rest of us did. I think it evolved the longer we met. Part of it was just writing tests and I hated that. I know it had to be done, but it was time consuming and tedious. I'm trying to think of a specific instance. We would discuss what we were looking at as far as the unit we were on, and every once in a while Fran and Chip would ask a question, or they would have us do an activity like the kids were doing it. It made a huge difference. I started looking at things in a different way. So those Saturday sessions were invaluable. It wasn't the discussion of the curriculum in those Saturday sessions, it was the chance to get together with other people who were teaching and talk about what was going on in our classrooms.

Mary pointed out a few important aspects that particularly made these Saturday meetings invaluable for her. She mentioned that the breakout sessions made a big difference on her pedagogy and the way she approached teaching.

Unlike Mary, however, a few teachers, who attended these sessions, were unhappy and shared that their experiences were insignificant, expressing doubts about their learning during these meetings. For example, Elizabeth, who was a veteran teacher and a mathematics coach, shared that she wanted to have more whole group discussions and peer-conversations with other teachers from the district, which she believed that such opportunities were very much missing during these sessions. Elizabeth also mentioned

that these sessions lacked direction and clear defined goals of what exactly the organizers

needed the teachers to do. Elizabeth explained that lack of direction made it difficult for

her and other teachers to make progress, stay on task, be motivated, and most of all, "see"

the purpose in these meetings:

> I think probably some of the worst, and I can pick on myself a little bit when I say it was some of the Saturday things we did. There wasn't a lot of direction, you could spend a whole lot of time talking and complaining. You didn't really see how purposeful it really was supposed to be. Although there was some progress made, it was really slow. I think part of that was because at that time that was the only opportunity you had to see anybody else from the other buildings, and so you really just needed some time to talk, but you felt like you weren't doing what you were supposed to do when you were doing that, so I guess that would probably be the weakest.

Teachers were put in groups in different rooms for this professional development to

complete their tasks. Perhaps the qualitative differences between the two groups (Mary's

group versus Elizabeth's group) had influenced teachers' experiences for this

professional development. However, besides Elizabeth there were a few other teachers

indicating they were unhappy as well.

Celeste, who just recently joined this district as a new teacher, spoke

disapprovingly about her experiences with the Saturday meetings as well:

> Sometimes, like in the math department or math district-wide. They will have a meeting on CMP. I don't know or teach CMP. So at this point in the game, granted will I teach CMP in the future, will I probably be learning something for something for further down the road? Yes. But right now, I have my plate full. And so don't make me go to a CMP meeting, where I teach Algebra and Integrated. You know, that kind of thing. When I was a music teacher, you would always go to PD meetings, and they'd bring in a band director from school that had 300 kids. Well, I had 30 kids in band. I'm not going to be able to do the same things that he's doing with 300 kids. So it would get very frustrating, because it's not relevant to what I'm doing. And yes, could I be a fabulous person and take notes and say – someday, I will teach CMP or someday- I will teach this. Yeah, I could be a grown up and do that, but I'm not. An you know, I was so excited when I started to teach Integrated. I was so excited, because everybody said the kids worked together and they come up with these great discussions and maybe

that's true in somebody's classroom, but it was not true in mine. And I have actually again, I'm probably going to get fired if anybody hears this. I've gone to a traditional style of teaching with my Integrated kids because their discussions basically they mimic everything that I say. Like I'll sit there and say, "Okay guys, what do you think about this?" And they sit there. And I'm like, "Well? Do you think it's good?" "Yeah it's good." You know, there's no thought behind a lot of what they say. And as far as working in groups, I try to do – I still try, "Okay guys, get with your partner" I got them and I number them off so it's sometimes it's a groups of 2, groups of 4, sometimes it's bigger, split the class in half. And literally, I have 2 kids that will sit down and do their homework, and I have 18 kids that will start talking about what their plans are for the weekend.

It was evident that Celeste's reasons for disparagement were entirely different from Elizabeth's. Celeste explained that she did not see the usefulness of the Saturday meetings because it was not related to her curriculum. She specifically mentioned that she was not teaching CMP at the time, therefore she was not interested in attending these meetings and learning about CMP.

Celeste also spoke about effective professional development being directly related to her present job duties and responsibilities, the curriculum she taught, and even the aptness of the professional development recommendations to her classroom and to the student population she was teaching. One of the other important aspects that Celeste brought up towards the end of the excerpt was her lack of interest in professional development due to the CMP curriculum teaching philosophy. Celeste openly suggested that her excitement about teaching integrated curriculum diminished after she had unsuccessful accounts trying to implement the integrated curriculum into her classroom. Celeste stated that her students were not fond and not responding well to the curriculum; therefore she actually practiced lecture-style teaching with the integrated curriculum. As a result, Celeste indicated that Saturday meetings were the least helpful or effective professional development for her, because they were not exactly related to the curriculum

she was teaching, not related to her students, and because it involved inquiry-based integrated teaching philosophy, which was in disagreement with Celeste's beliefs about teaching students' learning of mathematics.

As I continued to analyze teacher data many similar instances began to emerge. For example, teachers had mixed feeling about several professional developments they experienced together. Many of them seemed pleased and just as many disappointed with the same exact professional development sessions they attended. For example, one novice teacher talked about professional development in general, and which ones typically were better ones she typically attended:

> They were relevant, they were fun, they were hands-on, they kept us in mind in the sense of where we were and they talked and involved us in activities. But the ones that were not so good were the ones more policy based and needed to talk about some strategy or policy that needed to be discussed or revised; that was no fun. When you are looking at a document and revising the wording; that wasn't necessarily a professional development - more of a meeting that we had to do (Kira).

At the end of her conversation, this teacher stated that examining or reviewing policy documents, did not feel like professional development to her, more of a "no fun" meeting she was required to attend. The policy documents this teacher was referencing comprised mainly of the *state curriculum frameworks and grade level learning expectations* (GLE) for mathematics. The district had organized several meetings, during which the teachers reviewed the state requirements, analyzed and aligned these requirements to their curricular materials, and examined the district assessments to follow closely student achievements in regards to GLE. Similarly, this teacher also mentioned effective professional development being relevant to her current curriculum, job responsibilities, courses she taught, and include fun and hands-on activities.

Another teacher spoke about the same exact professional development (related to GLE), indicating that even though the session was not directly related to her classroom teaching, she still viewed it as worthwhile and informative, especially the part when she learned about the state expectations identifying the gaps in the student learning. This teacher, however, also had a few features that she did not like much, especially in regards to long-term outcomes as a result of professional development and teacher involvement:

> I said we spent time coordinating our GLE and our district assessments, which I feel is worthwhile. Along with that we looked at some student work with the tests, and that part I did find helpful too. But I feel like I should say this: we found some gaps, but then we didn't do anything to make improvements. I didn't feel like the work that we did was very helpful directly to my classroom instruction, other than making me a little bit more aware of where the gaps are. But I felt like there was kind of a lack of focus, and then no real outcome for this work, so I just spent three hours doing this work and there was no payout for me, I didn't feel like there was a huge payout for my students. What was the purpose? I mean the purpose that I understood from it is that by looking at the GLEs and how the GLEs and our unit tests are related, we would be able to identify places in our curriculum where we were either hitting GLEs, or we weren't hitting GLEs, but then we never came up with a plan. 'Well, if we're not hitting a GLE, what do we do? Do we make this up somehow? Do we need to emphasize this in another book?' We developed some safety net items of things kids absolutely have to have before they leave, but then there was no way to assess that, other than creating something on your own, which is a huge undertaking and very difficult to do. Or, just to do it anecdotally, which I don't feel is very effective or serves students very well. So it was pretty frustrating, we did it for a whole year, and then the worst part about it is that we found out the other group wasn't doing it, so the next year they said, 'Oh, the other group didn't do it so you're going to do it again this year,' and we were all so burnt out on it we just said, 'No, we can't.' (Lena)

This teacher expressed disappointment with this professional development for entirely different reasons that the previous teacher. She was more concerned and dissatisfied that the fact that teachers spent a whole year putting in work and hours looking at student work and examining state GLE's that eventually did not payoff in any way for the students. Evidently, this indicates that many teachers were motivated to attend and work

through this professional development because student learning was at the core of the professional development. Teachers worked hard because they desired to see district-wide decisions made related to narrowing the student achievement gap and the alignment gap of their curriculum and assessments, which unfortunately never came to fruition. Thus this teacher was unhappy not because she did not value professional development involving policy documents, but because teachers invested numerous hours into a mission, which in the end did not get realized by the district.

Another district-sponsored professional development program, for which the teachers provided differing responses, was called *Assessment for Learning*. This program was intended for all teachers in the district to eventually implement in their classrooms. The program focused on connecting student content learning between lessons, and explicitly stating the objectives of each lesson for the students to recognize and identity as specific topics and processes they are learning. This program was sponsored for several teachers from each school to attend and become leaders to provide leadership, ideas, and assistance to all teachers back in their schools, during the implementation of the program.

A high school veteran teacher, also a department chair, spoke keenly about this program. She mentioned that it had been influencing her teaching, especially the ways she made the mathematic explicit and assessed student learning:

> We've had some discussions, in math, our objectives tend to be pretty cut and dried; we are learning today how to learn about how to solve quadratic equations and we've got four different ways we're going to learn how to do it. We're going to look at this one today and this one tomorrow. So much of that feel so very cut and dried whereas a social studies teacher has an objective of the kids can be able to compare one culture to the next culture and all these different areas; they really have to hash out how they're going to do that and novels to read and what papers they're going to write and what projects they're going to create they really have to hash that out. So, in

some ways it's not as important for us as it is for some other areas. But I've just found that because of this I am doing a better job at trying to help kids make a connection between this lesson and this lesson and this lesson and this big idea that we need to be able to do and all the little components that fit together. And I still haven't figured out how to best make sense of all of that. I'm not there yet. But I am doing just the things I say when I launch the lesson and the things I say when I wrap it up at the end, and they are different now than what they used to be. Just from what's happened in August, September, and October (Amber).

From this conversation it was evident that if teachers appreciated the new idea and "saw" the usefulness and applicability of it in their own classrooms, especially if the idea involved specific instructional strategy that was believed achievable in their own classrooms, many teachers were willing to take the time to experiment with their own teaching and implement that idea into their practice. However, just the presentation and appreciation of the idea alone was not enough for the teachers to develop the vision and willingness for such experimentation, especially if the implementation of the idea was not clear, or understandable, or believed not achievable in their classroom. In fact, the next excerpt demonstrates that if the implementation of the idea is not clear the teachers least likely will take the time (or have the time) to learn about it on their own. Most importantly, if enough teachers do not "see" or understand the implementation of the idea into their practice it is most likely to become extinct:

P: I kind of don't do as much with them as I guess I'm technically supposed to. I mean they're like, 'Write them on the board' - but they don't tell you what to do with them. What am I supposed to do? Have them at the end of the week? Tell me how much of this stuff they can figure out, but then they don't really know themselves, they're not really good at self assessing, some are better than others, some are very unrealistic as far as what they're doing and where they're looking.

I: So what did you do?

P: Me personally? Part of the stuff they wanted us to do with that was a lot of - when they want to do assessment for learning it's like giving pre-tests prior to the test so they can do that, but I don't see how a pre-test that they do in class is a whole lot different than a review sheet of sorts. But then giving them the grade on that or having them read things over and over again, that has its own inherent problems. Honestly, I'm not doing a whole lot different than what I did previous

years, because I don't know how to apply some of the stuff, and some of the stuff they're like, ok well do all the stuff. I don't know what to do with it, I don't know how to do with it, and I don't have the time to do it. They gave us this big whopping book we're supposed to read that is written in technical terms half the time and I'm going, 'I don't know what you're talking about, and your book puts me to sleep anyhow. So I'm not getting out of it what you want me to get out of it'. And there are a lot of people in the district who are like, 'Well that's just another thing that's come through, a couple years ago we had other book studies'. My best friend teaches in St. Louis. This is her third year there. Her first year there they sent her to a conference in Oregon for this assessment for learning stuff. She said they did it for two years - this year they're big on the Marzano's stuff and they've kind of tossed the Assessment for Learning stuff aside. And part of it is, it almost seems like they want us to try all these things, but sometimes you don't know, some of the stuff isn't necessarily applicable to my room. So you're throwing all of these ideas at me and I'm going, I guess I can try to figure out how to make that work but it's not going to work as well (Mindy)

Mindy was very open about several factors that affected her learning and use of the

Assessment for Learning (AFL) ideas in her classroom. She explained that the limited

professional development she received on the general initiatives of the program was not

enough for her to fully understand and be able to realize those initiatives into her

classroom. Even though the district sponsored the supporting literature for this program,

the teachers are unavailable, unmotivated, and unequipped to read the research literature

and be able to fill-in the gaps on their own. Moreover, she stated that presently at the

district (after only four months) many teachers already feel detached and uninterested in

the AFL program and are simply waiting for the program to cease without at all trying to

implement it anymore.

Lindsey, a novice teacher, also spoke critically about the AFL program. Her

reasons were mostly related to the fact that she was looking to learn ideas that were

immediately related and applicable to her current courses and the classroom environment:

AFL is one of those things that you can't just completely in one day implement an AFL classroom. It's a multi-year long process, by adding little bits. Well that's great, but I want things that are immediate. I liked, we had one where we sat in,

and it was an Integrated [curriculum] meeting, and they gave us the schedule of when they wanted our testing windows to be. And you know something very small and stupid. But I was able to sit there and go, 'Ok, this is something that helps me today. It was something I didn't know, I now know it. We're good'. Yeah, and as a first year teacher, that's what you need. You need that immediate 'What I can I put into my room this second?' And implement. I mean, the smaller group setting – when we split off into particular curriculum, it wasn't just an entire mass district. It was junior high Integrated teachers.

Lindsey emphasized that as a novice teacher she needed only in instantaneous "procedure-result" type of suggestions from professional development and therefore was not at all interested in the AFL program, which as she realized required a year-long implementation process. Throughout my conversations with teachers about AFL professional development program, it was evident that teachers' response to this program was greatly affected by their perceptions and beliefs about what mathematics assessment entailed, and most importantly, it was affected by the teachers' perceptions and beliefs about professional development and what it should mean, involve, and require. It was also apparent that unless the district specifically defined and explicitly described the implementation, and the goals and purposes of the sponsored professional development initiative, the teachers were struggling and unmotivated to tolerate the ambiguities and not willing to find the answers and clarifications on their own.

One last professional development that many teachers mentioned specifically, from the district-sponsored programs, was related to the district-wide assessments and receiving training on the scoring of these assessments using the CAPI rubric: Concept, Answer, Process, or Incorrect marks. Once again, teachers' answers about this training varied due to the differences in perceptions and motivations about professional development, and beliefs about mathematics assessment. For example, Doug, a veteran

teacher, said he enjoyed the assessment scoring training and even noticed the

improvement in his own assessment skills:

> I put down grading examples of student work with peers. I was able to relate how I grade questions with others, which allowed me to become better at distinguishing between the CAPI grading system. Those were the best that I've been to. I actually learned how to look at my own work and assess how I do things and improve that. So that was what I liked about it.

Another veteran teacher Mary Lou also mentioned enjoying scoring assessments and

learning much from reviewing these assessments and having conversations with other

teachers about the differences in their scoring approaches. However, she complained that

this professional development has been offered and required numerously, and is actually

becoming too banal and mundane with no new and valuable ideas anymore - which is in

effect turning into a wearisome routine for teachers instead of a learning opportunity:

> Our district has gone to giving common assessments, so part of that is teaching students to grade them using a common rubric. And we spend a lot of time in our math department taking grade assessments, all in little groups and discussing how we graded them, and how we used the rubric and what we gave to student A and student B. We've done it a lot, and I just remember going to one not too long ago, and maybe had a sour taste about it because it's hard to get there, I had a lot going on, put my family on hold. And I get there with this important Professional Development {quotation gesticulation with her hands} - we really need you at. All we basically did, is we did more of that common grading, which was worthwhile the first six times I've done it with meetings. And even if we were grading my student's papers, that might've made it a little better, but we were grading a different grading level, so it wasn't a grade level I taught. I wasn't going to get nothing out of it, personally, looking at this particular problem. The rubric was flawed, and he was not willing – our district chair was not willing to change the rubric. So we basically practiced grading, which I already practiced grading on a test I was never going to give or use. And he was not going to change what all of us agreed was a flaw of the rubric – so not only did I feel like I got nothing out of it, no good came out of it. I was very frustrated after that. That was a total, total waste of time I felt like.

Earlier in the interviews, many experienced teachers when describing district-sponsored

professional development complained that repetitiveness is an important issue they see in

the district's professional development program. However, novice teachers complained

that they need the past professional developments to be repeated to catch them up to

speed with the district's changes. Thus, the assessment scoring training was pleasantly

perceived by all teachers; however the majority of those who spoke positively about them

were novice teachers. In fact, these teachers were both: novice to the school and novice to

this particular professional development. Nonetheless, even amongst the novice teachers

there were a few that were not happy about it either:

> It's more hassle than it's worth. All that came out of it was that we have these
> district rubrics and we all grade differently anyways. So you would spend three
> hours realizing, 'It doesn't matter what the rubric says for data, we're all grading
> differently anyway and there's no way to feasibly do that unless you have one
> person or one school grade one test and then take turns' - but that never happens.
> So there's a lot of data out there that's not the best (Ebony)

Several patterns surfaced from this conversation. Ebony spoke about spending three

hours on this task, which resulted in her lack of concern and interest. The reason she

became unmotivated was because she realized that the feasibility of reaching the goals

and ultimate objectives of this particular professional development seemed unreachable,

thus (in her mind) the intent defeated its purpose. This district practiced a data-driven

model as a motivation channel for teachers to modify, improve, and experiment with their

teaching. Teachers in the district often engaged in professional development that used

district-wide data to analyze the results and develop an improvement agenda. However, at

the end of the conversation, this novice teacher stated "there's a lot of data out there

that's not the best", meaning that the district-collected data may not be the best platform

for grounding and initiating district-wide improvement agendas.

Overall all teachers were motivated to learn, however finding time for learning

was a difficult task due to teachers' busy schedules. Consequently, teachers suggested

that a healthy degree of accountability and requirement for teachers to engage in learning

is needed to encourage and motivate them to follow their learning desires. However,

teachers also suggested that perhaps the requirements and accountabilities should lie

upon qualitative measures for teacher learning (such as implementation of the learnt ideas

into their own classrooms) rather than quantitative measurements, such as in-service

credits or hours. Teachers indicated that fewer district-sponsored professional

development but of high-quality is needed.

Assertions: How Did Mathematics Teachers Want to Learn?

Assertion 1: All teachers in this study pursued various learning opportunities and they defined learning differently.

Teachers classified themselves into three categories of learning: individual, community, or both. However, the descriptions of these learning types and their formats differed largely for many teachers, especially in regards to individual learning. For example, the teachers who identified themselves as individual learners, perceived learning as the act of trying out or testing an idea (related to teaching) in their own classrooms. Moreover, these teachers, even though recognized the presence of the community within their individual learning environment, did not however perceive the community to be part of the learning process itself. On the other hand, teachers, who did not identify themselves as individual learners, but provided examples of teacher individual learning, did not include any examples form their own classroom learning. These responses indicate that teachers differentiate classroom level learning from individual and community levels. Therefore, the teachers' responses indicated four (rather than three) levels of learning: a) individual level; b) classroom level; c) community level, and d) policy level.

Assertion 2: Teachers identified several models of learning as a community as the most desirable and effective, especially mentioning teacher reflections, sharing of ideas, visiting each other's classrooms, lesson study, study groups, and teacher discussion groups.

Overall all teachers described learning within their school community, including their departments and the building, as the most important, helpful, useful, and desired. Teachers especially mentioned professional development opportunities during which they

get to share ideas about teaching methods and strategies and reflect on practice. However, teachers talked about struggling to find time to have the opportunity to work and learn together especially during their contract hours, leaving no choice but meet after school, during evenings, and even week-ends. Teachers also talked about a great need for communication with each other as a community, (e.g., meeting, via email) and a critical need to have more opportunities to do so on a regular basis.

Assertion 3: Teachers identified a critical need to restructure (or differentiate) the district-sponsored professional development to address the qualitatively differing needs of novice teachers and experienced teachers.

In regards to learning within a larger community, both experienced and novice teachers voiced many concerns and dissatisfactions. The experienced teachers were dissatisfied with the quality of the district-sponsored professional development. They recalled instances where they were given the same information and activities repeatedly several times, and instances where the experienced teachers were asked to invest a great deal of effort and time into the district-persuaded tasks (such as analysis of district-wide student performance data) that resulted in no visible outcomes and were eventually disregarded by the district altogether.

The novice teachers also complained that the district-sponsored professional development need to be improved to help pull the novice teachers up-to-date with the district's developments, perhaps offering past professional developments again for novice teachers to make better sense of the district's vision about mathematics teaching and learning and curricular implementation.

Summary

In this chapter I reported the results from data analysis and the major findings of the study. These findings indicate that experienced and novice teachers' professional needs in general are very similar and center on the issues related to either aspects of mathematics teaching: student learning and motivation, instructional strategies, curriculum, assessment, classroom management, technology, mathematics as a content knowledge, and the teaching approaches and philosophies. However, experienced teachers' needs are closely situated within mathematics content and are more expansive than the novice teachers' professional needs.

Moreover, the novice teachers also indicated that their professional learning needs were different than those of experienced teachers. They indicated that some of the new information the novice teachers were learning during professional development was not new to the experienced teachers, and thus created tensions between the teachers. Novice teachers suggested the need for some of the professional development opportunities to be re-offered only for the novice teachers (to catch up with the rest of the district teachers), especially related to the curricular materials, curricular implementation, and the districts' vision about teaching and learning.

In regards to the content of the professional development, one major difference between the novice and experienced teachers was in the fact that novice teachers needed specific information on the implementation of the ideas into their classroom. Experienced teachers, on the other hand, were more flexible with the new ideas and indicated that they were willing to "tinker" with the ideas on their own to adapt them into their classroom. Experienced teachers also indicated that professional development does not always need

to focus on ideas they can take back to their classroom; novice teachers specifically mentioned that professional development that offered specific ideas or activities they can take back to their classroom were the most desired and most valued as effective opportunity to learn.

A commonality between the novice and experienced teacher responses related to the teacher community-centered learning. Both experienced and novice teachers valued and rated as the topmost desired method of learning – as community-centered. However, in both groups (novice and experienced) building a stronger, more supportive and more trusting community, was necessary for learning to occur and yield successful results.

These and other major findings will be closely examined in the next chapter, which contains final remarks, discussion, and conclusions of this study. In the next chapter I will ground the major findings within the reviewed literature, the theoretical underpinnings, and the conceptual framework of the study. As a conclusion, I will also offer future research directions related to teacher learning in general, and specific aspects of teacher learning that emerged as a result of this study.

CHAPTER 5: DISCUSSION AND CONCLUSIONS

The purpose of this study was to investigate one district as a case study of secondary mathematics teacher learning and professional development, by gaining teachers' personal insights and perceptions about the nature of their learning, characteristics and components of the professional development they deemed effective, and teacher professional learning needs. The research questions that guided the investigation and data analysis processes of the study included: *Why did secondary mathematics teachers from this district want to learn professionally?, What did secondary mathematics teachers from this district want to learn through professional development?,* and *How did secondary mathematics teachers from this district want to learn professionally?*

In this final chapter I outline the major findings of the project, connect the findings to the existing literature, and offer potential directions for future research. In particular, I organized this chapter to include: a) synopsis of findings (a repeat of the assertions contained in Chapter 4), b) discussion and implications, c) revisiting the framework, d) research limitations, e) recommendations for future research, and f) conclusions to the dissertation.

Synopsis of Findings

Why did secondary mathematics teachers from this district want to learn?

Assertion 1: Overall, teachers from this district were motivated to learn because of three main reasons: a) to improve teaching and as a result improving

student learning, b) to improve teachers' own qualifications and professionalism, and c) as a result of district's professional development requirements and accountability.

Assertion 2: Teachers' ability to transfer the learned knowledge from professional development settings into their classrooms influenced their motivation for professional learning. Experienced teachers, unlike novice teachers, were more flexible in regards to the implementation of the ideas and recommendations they learned during professional development. Novice teachers called for professional developers to include classroom connections into the content of the professional development and make those connections explicit, relevant, and clear-cut.

Assertions 3: Every teacher in this study, even those teachers identified as low-attendees of district's professional development, expressed a desire and willingness to learn. Moreover, every teacher in this study was able to describe in detail how they learned and what they learned on a regular basis both as part of the district professional development and as part of their own professional development. Several teachers, especially those teachers identified as low-attendees of district's professional development, provided specific reasons for why they were not attending district professional development largely referencing their learning needs not being met by the district's professional development.

Assertion 4: Teachers perceptions of learning impacted their definition of "effective" professional development. Moreover, even though every teacher in the study explicitly described his or her engagement in different professional learning opportunities - teachers' definitions of what constitutes "effective" professional development differed,

262

especially regarding the levels of teacher learning: individual, community, and policy levels. In this study, the predominant majority of teachers separated individual level of learning into two categories: individual level (learning to improve teacher's own development) and classroom level (learning to improve students' development).

Assertion 5: Teachers perceptions of learning impacted their rating and perceptions of the learning occurred during professional development. In this study, many teachers attended and participated in the same (or similar) district-sponsored professional development. However, teachers' descriptions of the learning occurred during those professional development sessions differed. Moreover, teachers' descriptions of the effectiveness and usefulness of those professional development sessions differed as well, especially for novice, experienced, and veteran teachers because of the difference in the stages of their careers.

Assertion 6: District and policy decisions impact teacher learning. Several professional development decisions in this particular district impacted not only *what* and *how* teachers learned but also impacted *why* teachers chose to engage or disengage in district-sponsored learning. Moreover, district's professional development decisions at times impacted the teacher community, weakening its structure and affecting teachers' interpersonal and professional relations.

What did secondary mathematics teachers in this district want to learn through professional development?

Assertion 1: The content of professional development and teachers' perceptions of "effective" professional development influenced teachers' motivation to learn. Teachers

rated professional development as "effective" if it focused on *eight* mathematics-specific topics related to teaching. Those eight topics included: curriculum, mathematics as a content knowledge, student learning and motivation, classroom management, technology, vision or philosophies of mathematics teaching, student assessment, and instructional strategies.

Assertion 2: Teachers' professional responsibilities impacted *what* teachers wanted or needed to learn, especially for teacher leaders, teacher mentors, department chairs, and teacher coaches. In this district, when teachers undertook organizational, leadership, or administrative responsibilities (beyond classroom teaching responsibilities), their professional learning needs expanded to include learning how to carry out those responsibilities – thus gaining professional knowledge related to administration and policy.

Assertion 3: Teachers years of experience and networking influenced the quantity and quality of professional learning opportunities they partook. More specifically, teachers with less teaching experience (and fewer year of networking) emphasized a great need for channels and ways to find information and resources about additional professional development opportunities outside of the district.

How did secondary mathematics teachers in this district want to learn professionally?

Assertion 1: Professional development structure and settings impacted teacher learning. Teachers indicated that the topmost desired process of learning was in a form of teacher collaboration and working together in a community setting. However, teachers indicated that to achieve "effective" teacher learning, the community of teachers involved

must be homogeneous. In this study, the predominant majority of teachers suggested that it was necessary to draw specific types of teachers together: teachers with common interests (in some cases beliefs) about mathematics teaching, teachers who share the same content area(s), teachers who teach similar grade levels, and teachers who teach the same curriculum (mentioned by a few teachers, who struggled with teaching the reform curricula).

Assertion 2: The timing for professional development impacted teacher learning. Almost all teachers in this study indicated that if the "timing is not right" it is extremely difficult to be motivated to learn. Teachers strongly suggested that learning opportunities need to be built into teachers' contract hours but scheduled outside of their teaching, so that teaching is neither sacrificed nor performed by other (substitute) teachers. In this study, the majority of teachers indicated that leaving their classrooms with substitute teachers was troublesome, taxing, and problematic - therefore it was difficult for them to concentrate on professional development while the substitute teachers were teaching their classes.

Assertion 3: The most desirable models of professional development and processes of teacher learning were identified as teacher reflections both individual and as a group, teachers' exchange of instructional ideas, visiting each other's classrooms, lesson study, common planning periods, study groups, and teacher discussion groups. However, the teachers in this study yet again indicated that these models of professional development are most effective when the teacher community involved is homogenous in their interests and beliefs about teaching, content area(s), grade levels, and (in a few cases) curricular materials.

Assertion 4: The teacher community and the quality of teacher professional and interpersonal relations greatly impacted teacher learning. In this district, experienced teachers, more than novice teachers, wanted to learn in a community setting; however, both groups of teachers (experienced and novice) failed to learn as a community on several occasions and, as a result, expressed an urgent need for building a stronger community of teachers *as learners*.

Assertion 5: Teachers' professional needs play a critical role in designing effective professional development, especially considering different stages of their professional careers. In this study, teachers identified a vital need to differentiate between the needs of novice teachers and experienced teachers (and in some cases teacher leaders), and to restructure professional development opportunities to address those needs more specifically and effectively.

<div align="center">Discussion</div>

Teachers as Learners

An alternative teacher learning model has been proposed to account for teacher learning processes in which the quality of learning is the direct result of their motivation for learning and how it affects their performance. Usuki (2001) proposed a theory of teacher learning, originated by Biggs & Telfer (1989), where teachers are metacognitive about their learning, meaning they become aware of their cognitive processes and monitor their own progress through the learning activities. At the heart of this learning is *autonomy*. Autonomous learners get ideas for effective learning through learning experiences; they transfer knowledge by drawing connections inside and outside the

learning experiences. Autonomous learners are self-analytical and are well aware of their learning capabilities, and they know what it takes for them to learn effectively without negatively affecting their future learning. Teachers who are autonomous learners constantly seek opportunities to learn, rather than waiting until these opportunities are offered or mandated (see Biggs & Telfer, 1989; Usuki, 2001). In this study, the teachers sought and engaged in various professional development opportunities; however, teachers' definitions of what constitutes professional learning differed as well as their ability to transfer knowledge and make connections inside and outside of the learning experiences. Experienced teachers were willing to ponder upon the challenges in adapting the new ideas into their classroom practices, whereas novice teachers strongly suggested the need for professional development to provide them with detailed information on how to implement the new ideas into their classrooms.

Moreover, teachers in this study defined professional learning, especially regarding the levels of learning (individual, community, policy levels). First and foremost, not all teachers defined classroom teaching as a community or individual level of learning. In fact, for some, classroom teaching as a learning context was its own separate level of learning because it involved a community of students; however, for many other teachers, teaching was part of the individual level of learning because teachers were learning individually inside their own classrooms. Furthermore, professional learning in the form of working together with other teachers and sharing ideas was perceived by some teachers as individual learning because they defined the act of learning to be in the process of implementing those ideas into their classrooms and not obtaining the ideas from colleagues. On the other hand, several teachers included

communication and collaboration with colleagues (including quick chats in the hallways and email) into their definition of a community learning.

Teacher Willingness to Learn

Van Eekelen, et. al. (2006) found that teachers vary in their *willingness to learn*. Some teachers are "eager to learn" - constantly seeking learning opportunities and easily recalling explicit information (both content and process) about their learning experiences. Alternatively, some teachers are "ready to learn" but do not know how, and some simply "do not see the need to learn" and hold onto their established habits of teaching. Van Eekelen and his colleagues argue that this group of teachers are not open-minded to suggestions or to others, often find it hard to describe their professional learning experiences, and attribute disappointments in their classrooms to external factors (e.g., school context, educational system, students) (Van Eekelen, et al, 2006). The findings of this study contradict these categorizations in several ways. First and foremost, all of the teachers in the study were able to explicitly recall their learning experiences (both process and content), including several teachers who were identified by the district as 'professional development low-attendees.' In fact, the comparison of responses from both the low- and high-attendees of professional development revealed that teacher responses about their learning experiences were consistent across both groups, regardless of district's attendance records. Second, in this study, several teachers, expressed that their beliefs about teaching differed from their textbook (both problems-based and single subject) and what they perceived as the philosophy of teaching/learning held by their district administrators. However, these teachers too were able to explicitly recall and describe their learning experiences. Third, teachers' years of experience and teachers'

professional needs played a determining role in their participation in professional development. For example, novice teachers were "ready to learn" but did not know how, and most importantly, did not know where to find the resources and additional opportunities for learning outside of the district. On the other hand, experienced teachers had built strong teacher networks and as a result collaborated and participated in professional development opportunities outside of the district. Moreover, the veteran teachers were largely focused on their leadership roles and sought professional development opportunities that closely aligned to these roles and the leadership duties.

Pedagogical Content Knowledge

Shulman (1987) argued that teachers have a special kind of knowledge -- *pedagogical content knowledge* (PCK). Teachers' PCK has been described as a *five*-dimensional model including: a) subject matter knowledge; b) knowledge of students' understanding; c) knowledge of curriculum; d) knowledge of assessment; and e) knowledge of instructional strategies (Grossman, 1990). However, PCK models and research has been focused largely on the developing knowledge of preservice teachers rather than on inservice teachers' professional development. In this study, the mathematics teachers, regardless of years of experience, concentrated on wanting to learn about eight central aspects related to mathematics teaching, five of which are closely mirrored to the model proposed by Grossman (1990). These eight aspects include: a) subject matter knowledge; b) knowledge of students' understandings; c) knowledge of curriculum; d) knowledge of assessment; e) knowledge of instructional strategies; f) knowledge about classroom management; g) knowledge of teaching philosophies; and h) knowledge of technology. Moreover, teachers indicated that teacher learning is at its peak

269

if each of these eight aspects are specifically related and situated within the content and the context of mathematics teaching.

Moreover, teachers who expressed needs to learn at each level of learning (individual, community, and policy) continued to mention these eight central aspects as the focus of the professional development content. For example, teachers spoke about assessment at the classroom level as formative and summative, referencing classroom activities and tasks they utilize to check for students understanding and on which to base their instruction. At the community level, teachers talked about assessment as teacher-developed common assessment units for the curricular materials adopted by the district. At the policy level, teachers mentioned the state mandated standardized testing procedures and student achievement.

Teacher Motivation to Learn

Historically, teacher motivation for professional learning and performance was defined, measured, manipulated, and explained through "*rewards.*" (Prostik, 1995; Kelly & Odden, 1995). Current research findings indicate that the present "reward system" is not effective in promoting teacher improvement on teaching and learning (Adelman & Kenyon, 1996). In fact, the majority of recent studies on teacher motivation through incentives and rewards have concluded that there is a tendency among teachers to overlook the importance of economic rewards and to overemphasize the importance of intrinsic ones (Ozcan, 1996). "Despite a century long history of the incentive programs, discovering what matters to teachers and how best to motivate them is still a complicated puzzle" (Ozcan, 1996, p. 4; also see Johnson, 1990; Rhodes & Ogawa, 1992; Cohn &

Kottkamp, 1993). In this study, teachers barely mentioned economic rewards as incentives for learning. In fact teachers suggested that the district should refocus its attention, requiring qualitative results from teacher learning rather than quantitative (e.g., inservice credits) results.

Teachers also indicated that the content of professional development needs to be narrowed in breadth but expanded in depth. Teachers strongly suggested that professional learning to be built-in to their professional contract hours, but separate (outside) from their teaching responsibilities. In social cognitive theory, *learning* is distinguished from *performance*. People may learn from observation; however the knowledge and skills they acquire may not be observable at the time of learning (Rosenthal & Zimmerman, 1978). In fact, "people will not demonstrate skills until they are motivated to display them" (Pintrich & Schunk, 2001, p. 149). Social cognitive theory postulates that *motivation* affects both learning and performance, and even though the two are separable, motivational inducement may grow and become powerful during learning (Pintrich & Schunk, 2001).

Recent research also suggests that teachers vary in their cognitive, affective, and meta-cognitive abilities to learn, especially that teachers vary in the way they reflect upon situations, transfer their knowledge, choose learning routes, and use learning resources (see Onstenk, 1997; also Bandura, 1997; Vermunt, 1996; Zimmerman, 2000). In this study, one difference was found between the ways experienced teachers and novice teachers transferred their knowledge and used learning resources. Experienced teachers were more flexible and willing to "tinker" with new ideas to adapt them into their classrooms. Novice teachers, however, strongly suggested that professional development

271

opportunities must include explicit and detailed information about the implementation of the new ideas into their classrooms. Moreover, experienced teachers' descriptions of professional learning were better situated within mathematics in comparison to novice teachers' descriptions, who spoke about teaching in general terms. For example, novice teachers described student learning in general terms, referring to group work, students' behaviors, and student motivation. Experienced teachers, on the other hand, situated student learning within the specific domain of mathematics (e.g., algebra, Pythagorean theorem) and were able to describe mathematics-specific aspects of student learning. Overall, unlike experienced teachers, the novice teachers had great difficulties transferring (and applying) the learned information into their classrooms and perceived professional development as "effective" particularly if the professional development included explicit classroom connections.

Teacher Efficacy

The number one reason that teachers provided for needing to learn was to be able to improve student learning and performance outcomes. Rotter (1966) identified teacher efficacy as the extent to which teachers believed they could influence (or control) student learning, achievement, and motivation. In other words, teachers believed that the reinforcement of their actions lay within themselves or within the environment, thus students' motivation and performance were believed to be significant drives for teaching behaviors. For example, teachers with high teacher efficacy believe they can control or at least strongly influence student achievement and motivation. This means that teachers in this study had a fairly high teacher efficacy. The findings of this study suggest that all teachers were driven to learn by their belief that they can improve students' learning

272

outcomes, achievement, and motivation if they continued to engage in professional learning. Thus, these teachers appeared to have high self efficacy around their learning.

However, teachers also shared that their drive to learn included their own need for learning as professionals. Thus, teachers' responses indicate that they felt perceived incompetence and that there was room for them to grow further as professionals and as individuals. At the core of their motivation was the act of gaining knowledge for their own accomplishment, development, and fulfillment, regardless of whether it was pedagogical knowledge, or content knowledge, or knowledge concerning their students, or academics and education, or everyday existence. Teachers talked about learning from reading professional literature or books, pursuing advanced or additional degrees, taking evening courses, or going through instructional materials such as textbooks, internet resources, or teacher notes they compiled. Teachers' perceptions about professional development played a significant role in their learning as well, especially in "seeing" the usefulness of the learnt ideas. Teachers had mixed responses (and feelings) about the same professional development opportunities, and thus had different learning outcomes as a result. Smylie (1988) suggested three categories of interrelated factors influencing change in individual teacher practice as a result of staff development opportunities: (a) teachers' pre-training psychological state, (b) characteristics of teachers' task environment (classroom), and (c) dimension of school context. Teachers' personal characteristics were found to impact their receptiveness to teacher development, yet social trust and teacher efficacy as personal characteristics related to teacher learning outcomes were found to evolve from professional development efforts (Fisler & Firestone, 2006).

Policy and Teacher Learning

In their recent study, *Does Policy Influence Mathematics and Science Teachers'*
Participation in Professional Development?, Desimone, Smith, and Phillips (2007)
argued that teacher engagement in contributing to professional development agendas and
opportunities to learn was associated with effective professional development. This study
supports these findings. Teachers in this study also suggested that teachers must be at the
forefront of developing the agenda for the professional development and building a
learning community of teacher-learners. However, the findings of this study also suggest
that policy immediately affects teacher learning and the teacher community through the
professional development decisions, programs, and context the schools and districts
create for teacher learning. For example, the teacher coaching model was a representative
example of this case. The district (not the teacher community) appointed the teacher-
coaches, which offended many senior and veteran teachers. As a result, experienced and
veteran teachers disagreed with the district's decisions and declined to participate in the
professional development program altogether. Consequently, the novice teachers also
declined to participate to avoid conflicts and outcasts within the community.

Teacher leadership has been one of the important issues widely discussed in
research studies on teacher learning communities (e.g., Ingersoll, 1999; Stigler & Hiebert,
1999; Wenger, 2001). Stigler & Hiebert (1999) argue that one of the problems schools
face is that few leaders exist among the teachers, making it a challenge to initiate and
provide leadership for needed reform efforts. This shortage of teacher leaders is impacted
by insufficient knowledge among our nation's teachers of mathematics (Ingersoll, 1999).
The results of this study indicate that teacher leadership must be initiated by the teachers

within the teacher community, instead of by the school and district administration. Moreover, teacher leaders must have extensive training and professional development on how to provide leadership to teachers with different backgrounds, teaching experiences, and professional learning needs.

NCLB has a substantial impact on teacher education, especially for practicing teachers who are currently working in public schools. It is affecting the *quality* and *nature* of professional development, the allocation of school or district resources, and the focus of teacher learning. For example, many school districts, for various reasons, continue to prefer and sponsor "one-shot workshops," which are usually in the form of a lecture, a workshop, or a meeting (Ball, 2002; Hill, Sleep, Lewis, & Ball, 2007; Selwyn, 2007; Wilson and Young, 2005). Ball (2002) states, "We have had strong reactions to the waste of time, to the lack of engagement of useful knowledge, to the often-poor pedagogy or dramatic style of such sessions, ….yet many of us [professional developers] have ourselves offered such sessions" (p. 10). Indeed, in this study, teacher responses supported these claims – teachers described many district-sponsored professional development experiences as being irrelevant to their classroom teaching, including "cheesy" activities, and being in a form of "one-shot workshop." Teachers indicated that professional development descriptions and advertisements need to focus not on a "buy-in" but on teacher learning outcomes and effectiveness, and the goals of the professional development need to be narrowly, but clearly, outlined and defined. Teachers also indicated that opportunities for teacher collaboration built into their contract hours and scheduled outside of their teaching would be "ideal" context for teacher learning.

Revisiting the Framework

I start by briefly summarizing and reminding the reader of the original framework *What and How Teachers Learn* used in this study proposed by Shulman and Shulman (2004) (see Figure 5.1). In this framework *what* teachers learn professionally was centered on four components: vision, understanding, practice, and motivation. Each of these components developed through teacher learning at different levels: individual, community, and policy level, which outlined the process of *how* teachers learn professionally. The aspect of *why* teachers learn professionally was not included in this framework.
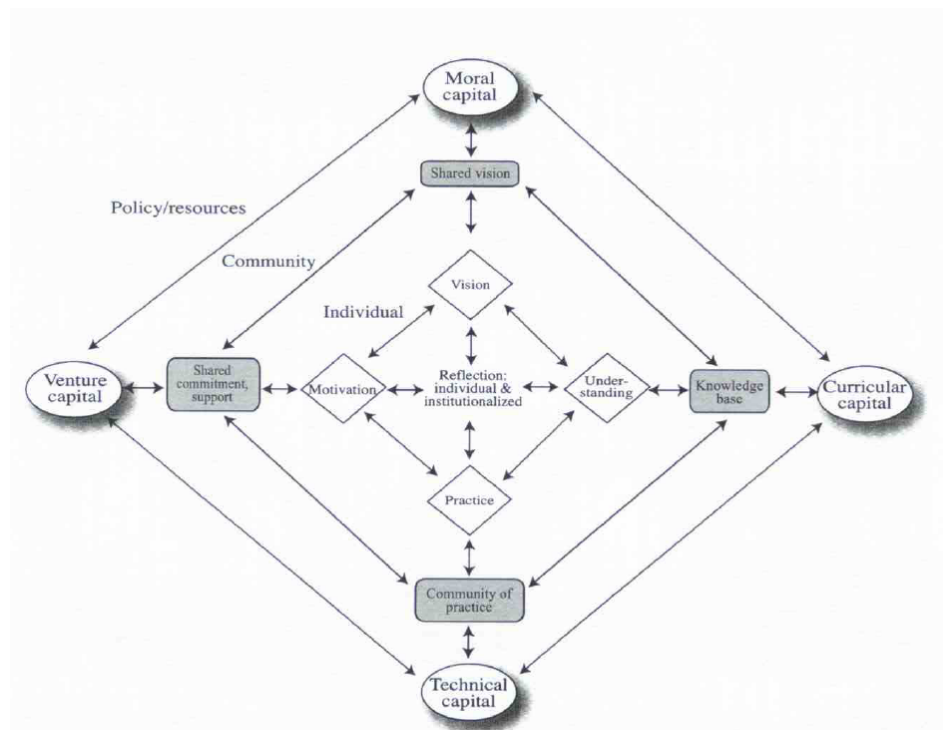
Figure 5.1. *What and How Teachers Learn* framework by Shulman and Shulman (2004)

I revisited and revised this original framework and proposed several modifications not only for the purpose of suiting the findings of my study, but also to possibly open a broader discussion within the educational and research community about *what* and *how* and *why* teachers learn. These three aspects of teacher learning guided my revision of the framework in several ways. Below I present descriptions and modifications I made for each of these cases.

Why did secondary mathematics teachers in this district want to learn?

In their framework *What and How Teachers Learn* Shulman and Shulman (2004) did not offer much explanation and description about *why* teachers participate and engage in professional learning. The findings of this study suggest that teacher motivation and engagement in learning opportunities was affected and driven by four different components: *self-driven, classroom-driven, community-driven, and policy-driven.* For example, teachers indicated that they practiced self-encouragement, by setting aside specific time (during summers or week-ends) to engage in learning. Teachers also indicated that at the classroom-driven level one the biggest motivations to continue to learn were their students, especially students' learning and reactions to the classroom practices enacted by the teachers. At the community-driven level, the majority of teachers indicated the need for building a stronger, more supportive and encouraging community of teachers to motivate teacher continued professional development. At the policy-driven level of motivation, teachers indicated that district's accountability and requirement for teacher learning, as well as financial support and availability of effective learning opportunities, serve as main vehicles for continued teacher professional development

What did secondary mathematics teachers in this district want to learn?

At the heart of Shulman and Shulman (2004) framework, especially related to knowledge bases of teacher learning, four central components were proposed as *What Teachers Learn*: vision, motivation, understanding, and practice. However, the results of this study indicate that teacher learning components may need to be expanded to account for additional knowledge bases teachers expressed the need and desire to learn. In fact, the findings of this study suggest that *What Teachers Learn* is centered on eight (not four) major components related to teaching: *a) content knowledge; b) knowledge about students' learning; c) knowledge of curriculum; d) knowledge of assessment; e) knowledge of instructional strategies; f) knowledge about classroom management; g) knowledge of teaching philosophies; and h) knowledge about technology.* Five of these components are closely mirrored to the knowledge bases of *pedagogical content knowledge* (PCK) proposed by Grossman (1990).

How did secondary mathematics teachers want to learn?

The original framework of the study was proposed to focus on three major levels of teacher learning: a) individual; b) community; and c) policy context. Similarly, Guskey and Sparks (1996) also argued that professional development produced various teacher learning outcomes depending on different levels of learning: a) *individual* teacher outcomes, such as teacher learning of new knowledge and teaching skills, and changes in teachers' classroom practices; b) outcomes in teacher *community*, especially in creating professional learning communities, teacher leadership and collaboration, and school development and culture; and c) *policy* outcomes, such as enactment of the district-

adopted curriculum, development and evaluation of the curricular programs, and involvement in school and district policy changes.

However, the findings of this study indicate that a shift in the perspective of *How Teachers Learn* is needed, calling for more expanded multi-level model of teacher professional learning focusing on four (not three) levels of learning: *individual, classroom, community, and policy level.*

At the individual level, teacher learning is comprised of a teacher as self and may involve reading professional literature, attending courses, pursuing additional degrees, and examining different channels and resources for self-development. At the classroom level, teacher learning comprises of the teacher and his or her students. It may include such opportunities as putting an instructional idea into practice or testing a new technological tool in the classroom. At the community level, teacher learning comprised of the teacher and the community of teachers (both school and district). It may include lesson study, teacher discussion groups, classroom observations, and common planning meetings. At the policy level, teacher learning still comprised of the teacher and the teacher community - however situated within a local, state, and national policy context of administrative guidelines and provisions. This level of learning may include discussion of student achievement data on the state-wide standardized tests, examination of the state curricular frameworks, analysis of national policy documents related to K-12 education and expectations.

As a result, I have modified the theoretical framework in several ways. Based on the findings of this study, I expanded the original model (Shuman & Shulman, 2004) to

include *eight* (not four) central components of *what* teachers learn. I also added one

additional level (classroom level) of teacher learning to account for four (not three) levels

of *how* teachers learn. Finally, I expanded the framework to reflect the affective domain

of teacher learning, in particular teacher motivation and engagement in professional

learning. Thus, in regard to *why* teachers learn professionally, the findings of this study

suggest that teacher learning is driven by four efforts: *self-driven, student-driven,*

community-driven, and administration-driven.

<center>Implications</center>

Implications for Teacher Education Research

In their recent report *Professional Learning in the Learning Profession* (Wei

et.al., 2009) the National Staff Development Council proposed several recommendations

related to teacher professional development. In the opening statement the authors defined

"high quality" or "effective" teacher learning as:

> Professional development, which results in improvements in teachers' knowledge
> and instructional practice, as well as improved student learning outcomes. We
> emphasize research that links teacher development to student learning (p. 3).

The results of this study indicate that teachers agree with this definition, and actually

define effective professional development in a similar way. Teachers suggested that

effective professional development offers them opportunities to learn new methods,

strategies, ideas, and tools that they can take back and use in their classrooms to help

improve student learning.

However, teachers also revealed that professional development that does not offer connections to their classroom practices and professional development that is not immediately relevant to their content-specific teaching is ineffective and futile to their learning. These suggestions are somewhat conflicting, especially in regard to teacher growth as professionals (beyond their classroom teaching). For example, teachers indicated that professional development involving a review of policy documents, such as state curricular frameworks, *Focal Points* (NCTM, 2007), or state grade-level learning expectations was ineffective, because it was not immediately relevant to their classroom teaching and did not offer new ideas and explicit instructional recommendations to help improve student learning. Teachers, especially novice teachers, indicated that such learning opportunities are a waste of their time. Such teacher perceptions and definitions of professional development directly affected teacher participation in professional development and their motivation to learn during this type of professional development.

As a result, one of the implications of this study is that teacher educators must pay a close attention to the goals and structures of professional development opportunities, offering explicit connections between the content of professional development and teachers' classroom practices. On the other hand, to implement the reform efforts and to advance the *Standards*-based teaching and learning, teachers need to be familiar with the government and policy developments and educational initiatives. Teachers need to recognize professional development that focuses on government, policy, and educational initiatives as effective and valuable learning opportunities, even though those may not necessarily offer instructional ideas and recommendations to take back and use in teachers' classrooms. To account for this type of teacher learning, perhaps the definition

of effective professional development should be expanded to not only focus on student achievement as a result of inservice professional development, but to also to focus on teachers' growth as individuals and professionals (as well as practitioners) as a result of inservice professional development.

Also, Wei and colleagues (2009) recommended several models of professional development that were found to be effective and successful, such as professional learning communities, peer observations of practice, analysis of student work, study groups, and lesson study. The results of this project complement these recommendations and offer additional insights regarding the focus and the structure of these professional development models. Teachers in this study indicated that professional development and professional learning communities need to be smaller (more intimate). Teachers indicated that community-centered learning and teacher discussion groups were extremely effective. However, the most effective opportunities rated by teachers can be characterized as 'teacher joint work' (Little, 1990). Little proposed a construct of 'teacher joint work,' meaning teachers have opportunities to collaborate in planning, implementing activities, and writing curriculum. Little further described teachers who jointly work with other teachers in grade level teams – and these teachers usually share students, content goals, and an understanding of effective teaching and student learning. Similarly, teachers in this study indicated that joint work was effective and useful. However, the findings of my study also suggested that joint work should be involve teachers who share common pedagogical views, teach the same content area at equivalent grade levels (grade band), and in some cases (particularly for novice teachers) use common curriculum materials. Most of the teachers in my study indicated that they

deemed ineffective and avoided professional development opportunities that involved

teachers from different content areas (interdisciplinary) or teachers from a wide-range of

grade levels (grades 6-12).

In regards to *what* teachers want to learn, once again content-specific professional

development was rated as the most effective. In fact, the findings of this study indicate

that pedagogical content knowledge (PCK) (see Grossman, 1990; Shulman, 1987) is one

of the most important aspects of effective professional development. Furthermore, the

findings of this study, also indicate the perhaps the five central components of

pedagogical content knowledge need to be expanded to include knowledge of technology,

knowledge of teaching philosophies, and knowledge of classroom management. The

majority of teachers suggested that they attended many professional development related

to classroom management; however classroom management during mathematics

instruction, especially using reform curricular materials, is different than instruction of

other subject areas. For example, a few teachers mentioned that student group work is not

always successful depending on the mathematical tasks and thinking the students are

accomplishing. Moreover, many teachers suggested that with the rapid growth of

technological developments, classroom teaching, especially teaching mathematics, has

been largely transformed and technologically evolved in the past ten years and that

professional development needs to account for those transformations and empower

teachers to take advantage of these developments.

In regard to teaching philosophies, professional development centered on

curricular examinations, development and implementation has been found to have

adverse consequences for teacher learning depending on its structure and execution. For

example, district-adoption of a *Standards*-based curriculum has resulted in teachers dividing in their opinions and beliefs about the nature of mathematical teaching and learning. Those who did not agree with the district's decision did not attend district-sponsored professional development for the implementation of the newly adopted curriculum. Moreover, these disagreements weakened the teacher community as a whole and their professional relationships with each other, jeopardizing teacher learning as a community.

Furthermore, Cohen and Hill (2001) described learning approaches that proved successful in California's statewide mathematics reform effort. The authors suggested that professional learning organized around new curriculum units engaged teachers in learning the mathematics in the new curriculum. Teachers taught the units and returned to debrief their experiences with other teachers and to problem solve next steps, while preparing to teach subsequent units. The teachers who participated in similar professional development have also rated these learning opportunities as effective. However, this type of professional development becomes problematic for novice teachers, especially novice hires in the school district that have been undergoing curriculum implementation for several years. Novice teachers and newly hired teachers indicated that entering the district in the middle of curriculum implementation, after the district had sect several years offering professional development focusing on the new curriculum units, has been difficult and extremely frustrating. These teachers indicated that perhaps repeating some of these professional development opportunities is necessary for the newly hired teachers to catch up with the district developments. In fact, teachers indicated that their

unfamiliarity and insecurity with the new curriculum aggravated some of the experienced

teachers, and resulted in discontented and fruitless learning of both groups of teachers.

Implications for Teacher Motivation Research

First and foremost, much research has been developed related to student learning

and achievement. Moreover, theories of motivations have been increasingly expanding,

focusing on student academic performance and motivation to learn. However, very little

research is available that centers on teacher learning, especially examining theories of

teachers' motivation to learn. Recent research suggests that some teachers want to learn

whereas others do not. This study does not support these findings, however it suggests

that *all* teachers want to learn but *what* and *how* they want to learn varies from teacher to

teacher. Most importantly, it varies *why* teachers want to learn professionally. Several

constructs surfaced from the teacher interviews, including teacher intrinsic and extrinsic

motivation, teachers' beliefs and perceptions about what constitutes effective professional

development, and teachers' added value for certain types of professional development;

however, it was extremely difficult to link and connect these constructs to specific

theories due to scarcely available research related to inservice teacher motivation to learn.

Therefore, theories of motivation and theories of learning need to be developed and

expanded further to better understand and explain many phenomena of teacher

professional learning.

Additionally, Garet and colleagues (2001), in reporting a recent national survey,

proposed that when teachers have an opportunity to do "hands-on" work that enhances

their knowledge of the content to be taught to students and how to teach it, and is aligned

with the curriculum and local policies, they report a greater sense of efficacy. Researchers suggest that high teacher efficacy predicts higher student achievement, whereas low teacher efficacy has a negative impact on students' performance (e.g., Cannon & Scharmann, 1996; Ross, Hogaboam-Gray, & Hannay, 2001). It has also been found that higher efficacy classrooms are usually represented by teachers who feel more prepared and by students who are relatively well behaved and of higher ability (Gibson & Dembo, 1984). As a result, teacher efficacy has been irrefutably connected to student achievement but scarcely connected to teacher learning. Current research on teacher efficacy is in great need to refocus its attention to examine teacher efficacy not as a result of teacher learning, but rather as a drive (motivation) for teacher learning. The results of this study indicate a relationship between teacher efficacy and teacher learning, especially related to teachers' desires to want to improve student learning and teachers' desires to want to improve their own learning as individuals and professionals.

Moreover, the refocusing of teacher efficacy research will require appropriate measures of teacher efficacy, currently unsuitable to account for *what* teachers want and need to learn, especially the critical components of pedagogical content knowledge. Global scores obscure the variation in teacher efficacy beliefs, especially for the studies that assess teachers' efficacy beliefs across different or multiple contexts (Raudenbush et al., 1992). Ambiguous wording in teacher efficacy surveys make the accuracy of measuring teacher beliefs troublesome. For example, one of the questions on the survey was *The teacher is generally responsible for the achievement of students in science* (Riggs & Enochs, 1990, p. 635). The ambiguity in the wording of this question is in the vague purpose or goal. Does this question assess one's confidence in his or her ability to

influence student outcomes or teacher's role in student achievement? Moreover, some of the wording makes it difficult to interpret the results gathered from that item. For example in the question *I can get through to even the most difficult or unmotivated students* (Tschannen-Moran & Woolfolk Hoy, 2001, p. 800; Gibson & Dembo, 1984). For this question it is necessary to know what the teachers define as "most difficult" or "unmotivated". These definitions might look quite different depending on the student population in each of the classrooms or schools.

Another issue is that for mathematics many of the instruments available are not effective or accurate enough in assessing teachers' efficacy beliefs, especially related to both the context and the content. For example, a teacher can have a strong belief about an ability to influence students' achievement in general, or when it comes to learning algebra. However, this may not be true if the teacher is asked to teach geometry or probability and statistics. Unfortunately, lack of items that assess or address teacher efficacy beliefs in regards to their subject matter knowledge, content areas of mathematics, or pedagogical content knowledge related to mathematics-specific curriculum, assessment, instructional strategies, and technology make teacher efficacy scales rather arcane to interpret (Wheatley, 2005).

Lastly, but certainly not least, one of the biggest issues researchers face today in examining teacher efficacy, specifically in mathematics education, is that many teachers may ground their teacher efficacy beliefs in traditional teaching approaches (e.g., show-and-tell strategies, rote memorization), which largely affect their learning, especially within the teacher community (Wheatley, 2005). Based on the currently available instruments, however, it would be difficult to measure the efficacy and confidence of

these teachers for standards-based or reformed teaching practices. Many of the items do not reflect or differentiate between different types of instructional strategies or teaching philosophies, thus leaving the possible conflicts between teacher efficacy and reformed teaching practices impossible to detect.

Implications for Policy Research

    Professional Development. Easton (2008) suggested that the most powerful teacher learning entails active learning opportunities embedded in teachers' work, which begins with teachers analyzing what their students need and, subsequently, what areas they need to address to improve their teaching and learning. Similarly, Elmore (2004) argued that "improvement above all entails learning to do the right things in the setting where you work" (p. 73). The findings of this study support these suggestions, especially regarding teachers' opportunities to learn being built into their contract hours and focusing on students' needs and critical areas for improvement. Indeed, the majority of teachers in my study suggested that professional learning opportunities must be integrated into their work days. However, teachers also suggested that professional development scheduled during their teaching, especially leaving their classrooms for substitute teachers to teach, was ineffective. Teachers explained that leaving their classrooms in the hands of substitute teachers keeps their minds distracted, worried, and unavailable for professional learning. Therefore, teachers suggested that those types of professional development rarely result in true teacher learning. Moreover, teachers suggested that besides their professional teaching and learning responsibilities, administrative duties (e.g., tutoring centers, cafeteria duties) are becoming overwhelming, but most importantly, those duties are becoming detrimental to teacher learning

opportunities. As a result, district-sponsored professional development must be restructured to accommodate teachers' learning contexts, contract time, and learning needs.

Teacher Community. Collaborative teacher learning has been found to be effective in promoting school change that extends beyond individual classrooms (see Hord, 1997; McLaughlin & Talbert, 2001; Perez et al, 2007). Many experts argue that successful coaching should be offered by accomplished peers and should include ongoing classroom modeling, supportive critiques of practice, and specific observations (Showers & Joyce, 1996). However, in my research, a teacher coaching model sometimes result in the teachers reporting conflicting learning outcomes. For example, some veteran teachers in my study refused to participate in coaching due to the disagreements with district's decision for appointing the coaches. Several experienced teachers also refused to participate in the teacher coaching because they perceived the model as expert-amateur training rather than community learning. Consequently, many novice teachers too refused to participate in teacher coaching because they did not want to appear as disagreeing with their more experienced teacher colleagues. As a result, the teachers in my study indicated that the teacher coaching model was ineffective as a professional development model, resulting in a lack of teacher learning and a weakened teacher community. Thus, professional development that requires teacher leadership, such as teacher coaching, must be approached with carefulness and forethought. Districts must be sensitive to teacher partnerships and teacher community, especially when appointing teacher-leaders; this research suggests that districts encourage teachers to participate in the decision making when appointing (or choosing) teacher-leaders. Districts also need to make the vision of

289

teacher-leadership very explicit, leaving no room for teachers' misperceptions or misinterpretations about the roles of teacher-leaders and the goal of teacher learning as a result of teacher-leadership.

Several implications specifically regarding the novice teachers are also requisite to mention. First and foremost, novice teachers were found to have qualitatively different learning needs than experienced teachers. In addition to struggling to apply knowledge learned during professional development into their classrooms, novice teachers indicated that being mentored by an experienced teacher (or a coach), especially mentoring that includes classroom visits and immediate feedback, had been the most effective professional development to learn about mathematics instruction. Second, Desimone and colleagues (2001) found that school stability, especially teacher sustainability and turnaround, played an important role in continued teacher learning. Indeed, the findings of this study agree with these recommendations. However, with teacher employment continuing to be in a constant state of flux, stability may be somewhat idealistic and impracticable to propose as a component for teacher learning. Thus, further research is needed to better examine and address the needs of novice teachers, especially new hires, to be able to help them successfully adapt into the district's policy initiatives and successfully assimilate into the teacher learning and teacher professional communities.

Limitations of the Study

This study allowed me to investigate and document several important aspects and features related to the nature of teacher professional learning. However, this research has several limitations that are important to consider.

First, the participants of this study were volunteers. Even though the sample included a wide range of teachers with different backgrounds, teaching experiences, grade levels, curricular materials, and attendance of district-sponsored professional development - the sample was not balanced and consisted of more teachers who attended and participated in professional development regularly. The sample imbalance made it somewhat difficult to draw inferences or comparisons between the two groups of teachers in particular: the low attendees and the high attendees of district-sponsored professional development.

Second, the data collected for this project was teacher self-reported data. Albeit multiple data sources being collected and triangulated between these sources, which resulted in a sizable consistency between teacher responses, yet caution must be observed while transferring the results and findings of this study to other educational and school contexts especially involving teacher learning and teacher professional development.

Third, for the purpose of this study I focused on one district as a case study keeping the policy context and professional development requirements the same for all teachers. However, a study that involve districts, different policy contexts, and contrasting professional development requirements would shed further light on teacher learning, not only in terms of components and levels of learning, but also establishing better relationship between policy contexts and teacher motivation to learn. Moreover, increasing the number of districts will ultimately increase the number of teacher-participants. In this study 35 teachers represented eight schools, which on average resulted in about 4-5 teachers per school. Bigger teacher sample representing each school would better depict the relationship between teacher learning and teacher community.

Fourth, no specific data were collected to better understand and document the nature of tensions and conflicts within the teacher community. Even though teacher individual interviews were extremely insightful, perhaps attending department meeting and school-based and district-based professional development would have been additionally valuable and beneficial to provide more details about the community level of teacher learning. Perhaps visiting teachers' classrooms would have been additionally helpful to understand the nature of the professional needs mentioned by the teachers during the interviews.

Finally, the district policy level data were not extensively collected, especially related to both mathematics and non-mathematics professional development programs that have been implemented in the past several years. Collecting these data would have allowed me to better triangulate the results and compare the teacher data and district data provided by the district coordinator. As a result, these limitations allowed me to only report the findings taking the unit of analysis to be each individual teacher and a group of novice, experienced, and veteran teachers. Unfortunately, the interplay between the unit of analysis to represent teacher responses as a school community or the district as a whole was neither easily possible nor successfully attempted for this project.

Recommendations for Future Research

Several potential avenues for future research are promising and needed. First, there is a strong relationship between teacher efficacy and teacher learning, especially in regard to teachers beliefs that they can improve student learning through professional

292

development. More research is needed to better understand this relationship and how teachers increase (or decrease) efficacy, and specific constructs of teacher efficacy that contribute to continued teacher learning.

Second, the findings of this study indicate that there is a considerable difference between the learning needs of experienced and novice teachers. More research is needed to better understand these differences, the nature of these differences, and effective models to better address teacher learning needs. The findings of this study suggest that there is a marked difference in PCK between experienced and novice teachers. For example, experienced teachers are more flexible than novice teachers in ability to transfer learned knowledge from professional development settings into their classrooms. More research is needed to better understand the nature of novice and experienced teachers' PCK differences, specifically examining experienced teachers' development of PCK over the years and what factors contribute to PCK development.

Third, many teachers in this study referred to specific learning methods when describing professional development focused on different (eight) components of teacher learning, including the five components of PCK. A difference in learning methods was found depending on the specific component. For example, teacher described that professional development focused on knowledge of effective instructional strategies or knowledge about student learning is best when situated in a group or community setting, enabling the teachers to converse and share ideas or classroom artifacts. However, teachers described that they favored learning about technology when situated alone (not in a group) being able to learn and familiarize themselves with the tool, and individually trying to use the tool during the professional development. Furthermore, when teachers

spoke about learning mathematics content, teachers did not agree on one specific style of learning describing group learning or individual learning or a combination of both. Some teachers indicated that they learned content best by solving mathematics problems in a group setting, whereas other teachers indicated that initially they needed time to do the mathematics alone, and only then (or eventually) reconvene back with a group of teachers to share and compare the results and strategies. Evidently, more research is needed to better understand the relationship between the topics (or content) and the effective methods for teachers to learn these topics.

Finally, the findings indicate that policy largely affects teacher learning, especially in regards to *what* and *how* teachers learn. Moreover, district-sponsored and required professional learning opportunities influenced teacher motivation to learn as well. Clearly, in the case of this particular district, policy contexts and administrative decisions caused a detrimental effect on teacher learning and teacher community. Research is desperately needed in the areas of positive (and negative) effects of policy on teacher learning, not only considering accountability for teacher professional development, but more importantly, the characteristics of policy contexts that bolster formation of a strong and supportive community of teacher learners.

Conclusion

I conclude this dissertation with several final remarks. First and foremost, teachers are learners regardless of their beliefs about teaching, epistemology, and student learning. Moreover, teacher professional learning is complex, multifaceted, and intricate.

This research suggests that teacher professional learning centers on eight major components of pedagogical content knowledge and rests on a four-dimensional model of learning, including individual, classroom, community, and policy contexts. Each of these components and contexts is critical for successful and effective teacher learning. Together these components and contexts frame a complicated model of teacher learning.

Ultimately, teacher learning is emergent, increasing, and different at each stage of teachers' professional careers. Effective professional development needs to focus on addressing the differing needs of novice teachers, experienced teachers, and veteran teachers. Professional development also needs to address the needs of teachers who serve as mentors, coaches, department chairs, and teacher leaders. Teacher learning is problematic and difficult to define, even for the teachers. In this study, among thirty five teachers the definitions of professional learning varied, establishing the critical need to better and further understand teacher learning not only through the eyes of teacher education but also through the eyes of the teachers themselves. It will help strengthen the infrastructure of teacher professional development, teachers' professional learning opportunities, and teachers' abilities to define what constitutes continued professional learning.

APPENDIX A: SUMMARY OF TEACHER PARTICIPANTS

NEW NAME	YEARS OF EXPERIENCE: 0-5, or 6-10, or 11-15, or more than 15	PD ATTENDANCE: low (30% or less) or high (70% or more)
Meadowbrook Middle School		
Patrick	6-10	LOW
Mary	OVER 15	LOW
Elizabeth	OVER 15	HI
Sunnylane Jr High	**Years of Experience**	**PD Attendance: low or high**
Celeste	OVER 15	LOW
Casey	0-5	HI
Carter	0-5	HI
Michelle	OVER 15	LOW
Colin	OVER 15	HI
Willowcreek Jr High	**Years of Experience**	**PD Attendance: low or high**
Nadia	OVER 15	HI
Mindy	11-15	HI
Pleasant Valley Jr High	**Years of Experience**	**PD Attendance: low or high**
Mike	0-5	HI
Aiden	6-10	HI
Grace	6-10	LOW
Olivia	6-10	LOW
Lindsey	0-5	LOW
Larry	6-10	LOW
Linden High School	**Years of Experience**	**PD Attendance: low or high**
Lena	OVER 15	HI
Michaela	0-5	HI
Danny	0-5	LOW
Ebony	0-5	LOW
Kira	0-5	HI
Kim	OVER 15	HI
Pansy	OVER 15	HI
Pat	11-15	HI
Fairview High School	**Years of Experience**	**PD Attendance: low or high**
Sidney	0-5	HI
Vicky	0-5	HI
Susann	0-5	LOW
Amber	OVER 15	HI
Hank	OVER 15	LOW
Rocheport Middle School	**Years of Experience**	**PD Attendance: low or high**
Zane	6-10	LOW
Mary Lou	OVER 15	HI
Alexis	OVER 15	LOW
Doug	6-10	HI
Ridgefield Middle School	**Years of Experience**	**PD Attendance: low or high**
Audrey	6-10	HI
Jane	0-5	HI
Gavin	11-15	HI

APPENDIX B: TEACHER INFORMED CONSENT

RESEARCH PURPOSE

The purpose of this research is to investigate the nature of your participation in district-sponsored professional learning opportunities. In particular, your insights on district-sponsored and other professional development (its usefulness to your profession, learning, and meeting your career needs), and the factors that influence your involvement in these opportunities. The research study will begin in the Fall of 2007 and conclude in the Summer of 2008. The data collection will begin in mid August and conclude at the end of Fall 2007.

INFORMATION

Your participation in this study is voluntary. If you decide to participate, you may withdraw from the study at any time. Only the researcher of this study will know the identity of individuals who choose to participate in the study.

PARTICIPATION

If you decide to participate, you will agree to:

1. Complete a short-answer questionnaire about your experiences with district-sponsored professional development. This questionnaire will serve as a basis for the teacher interview. This questionnaire will be distributed to you via email and will take approximately 30 minutes to complete. The questionnaire will be collected for analysis purposes on the day of the interview. Your name and records for this questionnaire will remain confidential at all times.
2. Participate in <u>one</u> interview scheduled at a time and location most convenient to you. The interviews will last approximately 1 hour and will be audio- taped and transcribed for analysis purposes. Your name and records of these interviews will remain confidential at all times.

BENEFITS

Your participation in this research study will help inform and improve the design of district-sponsored professional development opportunities, provide insights about the challenges and supports teachers need in professional development, and guide state and national policymakers regarding the guidelines for district-sponsored professional development opportunities. The information gained in this study may be published and may also be useful to mathematics teacher educators at other universities and colleges.

CONFIDENTIALITY

Your identity will be kept strictly confidential. The data collected during the study will be stored in a secure area in Townsend Hall of University of Missouri-Columbia. Information from your interview and questionnaire may be used in reporting the findings of this study and shared with my dissertation committee chair. However your name will <u>never</u> be used or shared and only the researcher will know your identity. You may choose to end your participation at any time during

the study. Data will be stored for three (3) years beyond the completion of the study and at that time it will be destroyed.

RISKS

This project does not involve any risks greater than those encountered in everyday life.

This project has been reviewed and approved by the University of Missouri-Columbia Human Subject Review Board. The Board is responsible for assuring the research procedures adequately protect your rights and welfare. For additional information regarding human subject participation in this research, please contact the University of Missouri-Columbia IRB officer at (573) 882-9585.

CONSENT

Please read the consent statement below and place an "X" next to the statement that describes your desire to participate in this study at this time. Sign and date the form.

I have read the information presented above.

_____ I hereby **agree** to participate in this research study. I am aware that my participation is voluntary and that I am free to withdraw participation at any time without any penalties to myself.

It is best to contact me via:

E-MAIL (below):	TELEPHONE (below):	ADDRESS (below):

_____ I **do not agree** to participate in this research study.

Signed: _____ Date: _____

Printed Name: _____

Thank you. If you have questions at any time, please call Aina Appova at the University of Missouri: (573) 884-4272/882-4061(secretary) or email me: aka883@missouri.edu. Alternatively, you can contact the chair of my dissertation committee, Dr. Fran Arbaugh, at (573)884-2068 or email her at: arbaughe@missouri.edu.

APPENDIX C: TEACHER SURVEY

Name_____**Date**_____**School**_____

Section I. General Information: Check or Highlight (if typing) all that apply

1. Are You:	2. How many years have you taught prior to this year?			3. When did you last complete a mathematics course for college credit	
☐ Male	☐ 0-2	☐ 2-5	☐ 5-10	☐ in the last 5 years	☐ 6-10 years ago
☐ Female	☐ 10-15	☐ 15-20	☐ 20-25	☐ over 25	☐ 11-20 years ago	☐ 20/more years ago

4. Have you taught one or more classes of advanced mathematics in the last three years (e.g., Algebra II, trigonometry, pre-calculus, calculus)?	5. What is your title?
☐ YES ☐ NO **If YES, the name of the course(s)? Write below**	☐ Math Dep't Chair ☐ Math Lead Teacher ☐ Assistant Principal ☐ Math Teacher ☐ Principal ☐ Other (write below)

6. Grade you teach? (write below)	7. Name(s) of the mathematics course(s) you are currently teaching? Write below:

8. Describe your educational background?	9. Race and Ethnicity – are you:
☐ Undergraduate major in Mathematics or Math Ed.	☐ Hispanic or Latino
☐ Undergraduate minor in Mathematics or Math Ed.	☐ American Indian or Alaskan Native
☐ Graduate major or minor in Mathematics/Math Ed	☐ Black or African American
☐ Certification to teach middle school mathematics	☐ Native Hawaiian or Other Pacific Islander
☐ Certification to teach high school mathematics	☐ Asian

☐ None of the above	☐ White	
10. I believe students learn mathematics best by: (write below)	**11. I learn mathematics best by: (write below)**	**12. In general, I learn things best by: (write below)**

Section II. Professional Development (PD) Information: Check or Highlight (if typing) all that apply

1. To what extent is each of the following true of mathematics related PD in your district?	Not at all			To a great extent	
a) I am involved in planning my mathematics-related professional development	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
b) I am encouraged to develop an individual professional development plan to address my needs and interests related to mathematics education	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
c) I am given time to work with other teachers as part of my professional development	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
d) I am given time to reflect on what I've learned and how to apply it to my classroom	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
e) I receive support from my district as I try to implement what I've learned	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

f) I receive support as I try to find other/outside PD opportunities that address my needs and interests related to mathematics education	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

What opportunities would you like to see more on the list of district's PD offers:

2. How many <u>total hours</u> have you spent on the <u>mathematics</u> related PD the district has offered?	Last 2 years	Last 5 years
	☐ 1-29 ☐ 30-69 ☐ 70-99 ☐ over 100	☐ 1-49 ☐ 50-99 ☐ 100-149 ☐ over 150

3. a) How would rate the overall quality of the <u>mathematics</u> related district-sponsored professional development?

☐ Very Poor   ☐ Poor   ☐ Fair   ☐ Good   ☐ Very Good   ☐ Excellent

3. b) How did you decide on the ratings?

POOR IS:

EXCELLENT IS:

4. To what extent has participation in district-sponsored <u>mathematics</u> PD increased your?	Not at all To a great extent
a) mathematics content knowledge	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
b) understanding students' thinking in mathematics	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
c) learning how to use inquiry-based or investigation-oriented teaching strategies	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
d) learning how to use technology in mathematics instruction	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

	Last 2 years				Last 5 years			

e) learning how to assess students' learning in mathematics	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
f) OTHER:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

2. How many <u>total hours</u> have you participated in each of the following activities?	**Last 2 years**				**Last 5 years**			
a. study groups or teacher discussion groups	☐ 1-29	☐ 30-69	☐ 70-99	☐ over 100	☐ 1-49	☐ 50-99	☐ 100-149	☐ over 150
b. instructional "coaching" by teacher-leader, staff person based on classroom observations	☐ 1-29	☐ 30-69	☐ 70-99	☐ over 100	☐ 1-49	☐ 50-99	☐ 100-149	☐ over 150
c. providing/receiving assistance from a teacher-leader or staff person without classroom visits	☐ 1-29	☐ 30-69	☐ 70-99	☐ over 100	☐ 1-49	☐ 50-99	☐ 100-149	☐ over 150
d. providing/receiving assistance by designated mathematician or mathematics educator from college, university, industry	☐ 1-29	☐ 30-69	☐ 70-99	☐ over 100	☐ 1-49	☐ 50-99	☐ 100-149	☐ over 150
e. read, write, or discuss publications, newsletters, manuscripts related to mathematics or mathematics education	☐ 1-29	☐ 30-69	☐ 70-99	☐ over 100	☐ 1-49	☐ 50-99	☐ 100-149	☐ over 150
f. attend and participate in professional meetings or conferences	☐ 1-29	☐ 30-69	☐ 70-99	☐ over 100	☐ 1-49	☐ 50-99	☐ 100-149	☐ over 150
g. plan my own mathematics-related professional development	☐ 1-29	☐ 30-69	☐ 70-99	☐ over 100	☐ 1-49	☐ 50-99	☐ 100-149	☐ over 150

LIST ANY OTHER ACTIVITIES THAT ARE NOT INCLUDED HERE THAT YOU PARTICIPATED IN:

5. How many <u>total hours</u> have you spent on the <u>non-mathematics</u> related PD (district-sponsored or outside the district)?	Last 2 years	Last 5 years
	☐ 1-29 ☐ 30-69 ☐ 70-99 ☐ over 100	☐ 1-49 ☐ 50-99 ☐ 100-149 ☐ over 150

6. How would rate the overall quality of the <u>non-mathematics</u> related district-sponsored professional development?

☐ Very Poor   ☐ Poor   ☐ Fair   ☐ Good   ☐ Very Good   ☐ Excellent

1. Among all of the PD's you have attended, describe the one that was <u>most useful</u> and valuable to you. It was useful/not useful in the fact that:	2. Among all of the PD's you have attended, describe the one that was <u>least useful</u> to you. It was useful/not useful in the fact that:

7. If you were to design an "ideal" professional development for <u>each</u> of the following areas of mathematics teaching what would it include:

Learn more mathematics content knowledge	Understand students' thinking in mathematics	Learning about innovative instructional strategies	Learn how to use technology in mathematics instruction	Learn how to better assess students' learning in mathematics

1.   When I say "professional development" what comes to mind? Why?

2.   What do you usually look for in PD? When you know that you definitely want to attend PD, what are the most determining factors?

3.   Describe overall PD experiences that you had so far.
             Probe: examples, types of PD, content of PD, activities of PD.

4.   Do you have time to learn? What do you do? How do you typically learn?

5.   This project is about the voices of teachers than need to be heard about PD, their quality, their usefulness, and their helpfulness. What are the major messages you want to get across?

6.   What do you think PD should include that would help you personally to achieve the highest level learning possible?

7.   When describing "ideal" professional development:
             a.   How did you come up with these descriptions?
             b.   What are some of the things you would like to learn for each?
             c.   How would you personally like to learn about these things? What are the way(s) that work "best" for you? (settings, activities, your role, teacher educator's role)
             d.   How do you know when you learned something?

8.   When you think about attending professional development:

             a.   What matters the most to you? (Probe about: Incentives, mandatory)
             b.   Do past PD experiences matter in making that decision?
             c.   What else is an important factor that helps you determine to attend or not attend the PD? Probe: Other factors that also play an important role? Ask each specifically: Does the type of PD, content, activities, the setting(s), and what is expected to be learned influence? If yes, why?

9. You described useful and "not useful" professional development experiences; tell me more about these experiences:
    Probe: type of PD, content of PD, activities of PD, the setting(s), what was learned, why was it useful.

10. You described professional development attended in the past 2-5 years: were these mandatory? What made you chose to go to the optional ones?

11. Every district has a vision of how mathematics should be taught. What is the vision at your district? How do you know?

12. You described professional development that increased your knowledge. Knowledge of what exactly? What were most helpful characteristics that helped increase your knowledge?

13. Do you best learn individually or as part of a group? How often do you get to work with other teachers? What do you typically do? How helpful is it for your learning? What would you like to do more on your own? What would like to do more with a group of teachers?

14. What are some of your current professional needs that you'd like to address through PD in the nearest future? In what ways would you like for those needs to be addressed?

15. What are some other things you want to learn that would be helpful to you as a math teacher? Why do you want to learn these? How: Probe: Type? Setting? Activities?

16. You described opportunities that you'd like to see more on the list of the district's PD offerings. Why those particular ones?

APPENDIX E: MATHEMATICS DISTRICT COORDINATOR INTERVIEW QUESTIONS

1. How many hours of mathematics related professional development the district has offered in the past 5 years. Tell me about these professional development opportunities?
2. Who usually design these? Who else?
3. How did _____ usually decide on the design and the structure for these PD's?
4. How did _____ usually decide on the content and material for these PD's?
5. How did _____ usually decide on the length of these PD's?
6. How did _____ usually decide on how often to offer PD?
   a) Were there some PD's in the past 5 years offered more than others? If yes, probe "Why?"
7. Were teachers usually followed up on their learning and how they applied the learned material in their classrooms?
   a) If yes, probe "How was that done?"
   b) "Other ways that it has been done in the past?"
   c) "How helpful were the follow-ups for the district?"
   d) "How helpful, in your opinion, were the follow-ups for the teachers?"
8. Tell me about mathematics related PD in the past 2 years.
9. What has changed from the things that have been done in the past 5 years?
   a) Probe for who designs the PD's now? Who else?
   b) Probe for the design and structure of the PD, describe please
   c) Probe for the content and material of the PD
   d) Probe for the length or duration of the PD
   e) Probe for frequency of the PD
10. How did you usually recruit teachers to participate in PD's? What about in the past 2 years?
11. What happens to those who do not come?
12. What are usually the reasons?
   a) If reasons are known, probe "How are those addressed?"
13. How, in your opinion, has teacher attendance been in the past 2 years? Are there noticeable differences in attendance for required versus optional PD?
   a) If yes, probe for "why do you think that is?" What about in the past 5 years?
14. Are there teachers who almost never participate in PD unless it's required?
   a) If yes, "What is the district's policy on that?" "Other ways the district tried to address that matter?"
15. What would be your suggestion in regard to why teachers do not participate in PD? How, in your opinion, can we increase teacher participation in PD?
16. Look at the framework by Shulman & Shulman (2004) I am using for my study about teacher learning. Do you believe it describes the learning of teachers in your district? Which components are strongly present in the district? Which components are weak? Why do you think that is?
17. What is the district vision in terms of student learning?
18. What is the district's vision in terms of teacher learning?

BIBLIOGRAPHY

Agne, K. J. (1992). Caring: The expert teacher's edge. *Educational Horizons, 70*(3), 120–124.

Amit, M., & Fried, M. N. (2002). Research, Reform, and Times of Change. In L. D. English (Ed.), *Handbook of International Research in Mathematics Education* (pp. 355-381). New Jersey: Lawrence Erlbaum Associates.

An, S., Kulm. G., Wu, Z. (2004). The pedagogical content knowledge of middle school, mathematics teachers in China and the US. *Journal of Mathematics Teacher Education, 7*, 145-172.

Archer, J. (1998). The link to higher scores. *Education Week on the Web.* [On-line] Available: http://www.edweek.org/sreports/tc/tc98/ets/ets-n.htm

Arbaugh, F. (2003). Study groups as a form of professional development for secondary mathematics teachers. *Journal of Mathematics Teacher Education, 6,* 139–163.

Armisted, C. (1984). How Useful are Case Studies. *Training and Development Journal, 38 (2),* 75-77.

Ashton, P. T., & Webb, R. B. (1986). *Making a difference: Teachers' sense of efficacy and student achievement.* New York: Longman.

Ball, B.L., & Cohen, D.K. (1999). Developing practice, developing practitioners: Towards a practice-based theory of professional education. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 3-32). San Francisco, CA: Jossey-Bass

Ball, D.L. (1997). What do students know? Facing challenges of distance, context, and desire in trying to hear children. In B.J. Biddle, T.L. Good, & I.F. Goodson (Eds.), *International handbook of teachers and teaching* (Vol. II, pp. 769-818). Dordrecht: Kluwer.

Ball, D. L. (1995). *Developing mathematics reform: What don't we know about teacher learning – but would make a good working hypotheses?* National Center for Teaching and Learning Mathematics. Lansing, MI: Research Report.

Ball, D.L. (1988). *Knowledge and reasoning in mathematical pedagogy: Examining what prospective teachers bring with them to teacher education* (Unpublished doctoral dissertation, Michigan State University, East Lansing, MI).

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control.* NY: W. H. Freeman and Company.

Begle, E.G. (1972). *Teacher knowledge and student achievement in algebra.* Palo Alto, CA: Stanford University Press.

Belcastro, F.P. &Isaacson, D.K. (1992). Professional development: Problems and solutions. *Journal of Instructional Psychology,* 19(3), 143-147.

Berman, P., McLaughlin, M., Bass, G., Pauly, E., and Zellman, G. (1977). *Federal programs supporting educational change, v. 7: Factors affecting implementation*

and continuation. Santa Monica, CA: The Rand Corporation. (ERIC Document Service No. ED 140 432).

Bolin, F. & McConnell-Falk, J. (Eds.). (1986). *Teacher renewal: Professional issues, personal choices.* New York: Columbia Teachers College Press.

Borich, G. (1996). *Effective teaching methods.* (3rd Edition). New York: Macmillan.

Bradley, A. (1996). Teachers as learners. *Teacher Magazine,* 7(9), 31-36.

Brophy, J., & Good, T.L. (1986). Teacher behavior and student achievement in M.C. Wittrock (Eds.), *Handbook of research on teaching.* New York: Macmillan.

Clark, C.M., & Peterson, P.L. (1986). Teachers' thought processes. In M.C. Wittrock (Ed.), *Handbook of research on teaching* (3rd edition, pp. 255-296). New York: Macmillan.

Cohen, D.K. (1990). A revolution in one classroom: The case of Mrs. Oublier. *Educational Evaluation and Policy Analysis, 12*(3), 327-45.

Cohen, D. K., & Hill, H. C. (2001). *Learning policy*. New Haven, CT: Yale University Press.

Cobb, P. et al. (1992). Characteristics of Classroom Mathematics Traditions: An Interactional Analysis. *American Educational Research Journal*, *29*, 573-604.

Cooney, T. (1994). Research and teacher education: IN search of common ground. *Journal for Research in Mathematics Education, 25*(6), 608-636.

Coxford, A. F., and others. (1998) *Contemporary mathematics in context: A unified approach*. Glencoe/McGraw-Hill.

Darling-Hammond, L., & Sykes, G. (1999). *Teaching as the learning profession: Handbook of policy and practice*. San Francisco, CA: Jossey-Bass.

Davey, L. (1991). *The Application of Case Study Evaluations.* ERIC/TM Digest.

Desimone, L., Porter, A., Garet, M., Yoon, K., & Birman, B. (2002). Effects of professional development on teachers' instruction: Results from a three-year longitudinal study. *Education Evaluation and Policy Analysis, 24*(2), 81-112.

Desimone, L., Smith, T., Phillips, K. (2007). Does Policy Influence Mathematics and Science Teachers' Participation In PD? *Teachers College Record, 109*(5), 1086-122

Duran, M. (2000). Preparing technology-proficient teachers. In D. A. Willis, J. D. Price, and J. Willis (Eds.), *Proceedings of SITE 2000* (pp. 1343-1348). Charlottesville, VA: Association for the Advancement of Computing in Education.

Dzubay, D. (2001). *Understanding motivation & supporting teacher renewal. quality teaching and learning series.* Northwest Regional Educational Laboratory, 101 S.W. Main Street, Suite 500, Portland, OR 97204

Easton, L. B. (2008). From professional development to professional learning. *Phi Delta Kappan*, *89*(10), 755-759.

Eaton, C. (2005). Sparking a revolution in teaching and learning. *T.H.E.Journal, 33*(1)

20-24.

Elmore, R. F. (1993). The role of local school districts in instructional improvement. In S. H. Fuhrman (Ed.), *Designing coherent educational policy: Improving the system* (pp. 96-124). San Francisco: Jossey-Bass.

Eraut, M. (2000). Non-formal learning and tacit knowledge in professional work. *British Journal of Educational Psychology, 70*, 113-136.

Even, R. (1993). Subject-matter knowledge and pedagogical content knowledge: prospective secondary teacher and the function concept. *Journal for Research in Mathematics Education, 24*(2), 94-116.

Even, R. (1990). Subject-matter knowledge for teaching and the case of function. *Educational Studies in Mathematics, 21*, 521-544.

Even, R., & Tirosh, D. (1995). Subject-matter knowledge and knowledge about students as sources of teacher presentation f the subject-matter. *Educational Studies in Mathematics, 29*(1), 1-20.

Fennema, F., & Franke, M. L. (1992). Teachers' knowledge and its impact. In D. A. Grouws (Ed.), *Handbook of mathematics teaching and learning* (pp. 147-164). New York: Macmillan Publishing Company.

Fisler, J., & Firestone, W. (2006). Teacher learning in a school-university partnership: Exploring the role of social trust and teaching efficacy beliefs. *Teacher College Records, 108*(6), 1155-1185.

Floden, R., Porter, A., Alford, L., Freeman, D., Irwin, S., Schmidt, W., et al. (1988). Instructional leadership at the district level: A closer look at autonomy and control. *Educational Administration Quarterly,* 24, 96-124.

Fullan, M. G. (1999). Getting reform right: What works and what doesn't. *Phi Delta Kappan, 73*(10), 744–752.

Gage, N. (1978). *The scientific basis of the art of teaching.* Teachers College Press, Columbia University, NY. Grossman, P. L. (1990). *The making of a teacher: Teacher knowledge and teacher education.* New York: Teachers College Press.

Garet, M., Porter, A., Desimone, L., Birman, B., & Yoon, K.S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*(4), 915-945.

Ghaith, G., & Yaghi, H. (1997). Relationships among experience, teacher efficacy, and attitudes towards the implementation of instructional innovation. *Teaching and Teacher Education, 13*(4), 451–458.

Good, T.L., Grouws, D.A., Ebmeier, H. (1983). *Active mathematics teaching.* New York: Longman.

Geertz, C. (1973). Thick description: Toward an interpretive theory of culture. *The interpretations of cultures* (pp. 3-30). NY: Basic Books, Inc.

Grossman, P. L. (1989). A Study in Contrast: Sources of Pedagogical Content Knowledge for Secondary English, *Journal of Teacher Education, 40* (5), pp. 24–

31.

Guskey, T. (1988). Teacher efficacy, self-concept, and attitudes toward the
implementation of instructional innovation. *Teaching and Teacher Education,*
4(1), 63-69.

Hafner, A.L. (1993). Teaching-method scales and mathematics-class achievement: What
works with different outcomes? *American Educational Research Journal, 30*(1),
71-94.

Harel, G., & Lim, K. H. (2004). *Mathematics teachers' knowledge base: preliminary*
results. Paper presented on the 28th Conference of the International Group for the
Psychology of Mathematics Education.

Hashweh, M. Z. (2003). Teacher accommodative change. *Teaching and Teacher*
Education, 19, 421-434.

Heck, D. J., Banilower, E.R., Weiss, I.R., Rosenberg, S.L. (2008). Studying the effects of
professional development: The case of the NSF's local systemic change through
teacher enhancement initiative. *Journal for Research in Mathematics Education*
39 (2), 113-152.

Herman, J.L., & Klein, C.D. (1996). Evaluating equity in alternative assessment: An
illustration of opportunity-to-learn issues. *Journal of Educational Research,*
89(4), 246-256.

Herbert, S., Gorman, H. S. (1921). *New York Times (1857-Current file).* ProQuest
Historical Newspapers: The New York Times (1851 - 2001), pg. 43

Hiebert, E. H. (1987). The context of instruction and student learning: An examination of
slavin's assumptions. *Review of Educational Research, 57*(3) 337-340.

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical
knowledge for teaching on student achievement. *American Educational Research*
Journal,42, 371-406.

Hill, H. C., Schilling, S. G., & Ball, D. L. (2004). Developing measures of teachers'
mathematics knowledge for teaching. *Elementary School Journal, 105,* 11-30.

Hord, S. M. (1997). *Professional learning communities: Communities of continuous*
*inquiry and improvement*Southwest Educational Development Laboratory, 211
East Seventh Street, Austin, TX 787601.

Jackson, P. (1968). *Life in classrooms*. New York: Holt, Rinehart and Winston.

Keating, T. M., & Evans, E. (April 2001). *Three computers in the back of the classroom:*
Pre-service teachers' conceptions of technology integration. Paper presented at
the Annual Meeting of the American Educational Research Association, Seattle,
WA.

Koirala, H. P. (2002). *Facilitating student learning through math journals* . Retrieved on
June 16, 2007, from ERIC database.

Lampert, M. (1988). What can research on teacher education tell us about improving
quality in mathematics education? *Teaching and Teacher Education, 4*(2), 157-

170. Lewis, L., Parsad, B., Carey, N., Bartfai, N., Farris, E., & Smerdon, B. (1999). *Teacher quality: A report on the preparation and qualifications of public school teachers* (NCES 1999-080). Washington, DC: National Center for Education Statistics. [On-line] Available : http://nces.ed.gov/pubs99/1999080.pdf

Lappan, G., Fey, J., Fitzgerald,W. M., Friel, S., & Phillips, E. (1996). *Getting to know connected mathematics.* White Plains, NY: Dale Seymour.

Lave, J. (1988). *Cognition in practice: Mind, Mathematics and culture in everyday life.* Cambridge, Cambridge University Press.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* Cambridge: Cambridge University Press.

Leinhardt, G. and Smith. D.A. (1985). Expertise in mathematics instruction: Subject matter knowledge. *Journal of Educational Psychology, 77,* 247-271.

Lin, F.L., & Cooney, T.J. (2001). *Making sense of mathematics teacher education.* The Netherlands: Kluwer Academic Publishers.

Little, J. W. (1993). Teachers' professional development in a climate of educational reform. *Educational Evaluation and Policy Analysis, 1*(15), 129-51

Lord, B. (1994). Teachers' professional development: Critical colleagueship and the role of professional communities, pp. 175-204. In N. Cobb (Ed.), *The Future of Education: Perspectives on national standards in America.* New York: College Entrance Examination Board.

Loucks-Horsley, S., Hewson, P. W., Love, N., & Stiles, K. E. (1998). *Designing professional development for teachers of science and mathematics.* Thousand Oaks, CA: Corwin Press.

Ma, L. (1999) *Knowing and teaching elementary mathematics.* Mahwah NJ: Erlbaum

McCaffrey, D.F., Hamilton, L.S., Stecher, B.M., Klein, S.P. Bugliari, D., & Robyn, A. (2001). Interactions among instructional practices, curriculum, and student achievement: The case of standards-based high school mathematics. *Journal for Research in Mathematics Education, 32,* 493-517.

Manouchehri, A. & Goodman, T. (1998). Mathematics curriculum reform and teachers: Understanding the connections. *The Journal of Educational Research, 92,* 1, 27-41.

Mason, D.A., & Good, T.L. (1993). Effects of two-group and whole-class teaching on regrouped elementary students' mathematics achievement. *American Educational Research Journal, 30*(2), 328-260.

Moore, J., & Barab, S. (2002). The inquiry learning forum: A community of practice approach to online professional development. *TechTrends, 46*(3), 44-49.

Moreno, N. P., Griffin, R. A., Denk, J. P., & Jones, W. (2001). Real-world science: Achieving better returns in student learning. *School Business Affairs, 67*(8) 17-20.

National Council of Teachers of Mathematics (1989). *Curriculum and Evaluation Standards for School Mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics (1991). *Professional Standards for Teaching Mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics (1995). *Assessment Standards for School Mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics (2000).*Principles and Standards for School Mathematics.* Reston, VA: Author.

Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: A focus on pedagogical content knowledge. *Journal of Teacher Education.*

Onstenk, J.H.A.M. (1997). *Learning to learn from work: The integration between learning, working, and innovation.* (Unpublished Doctoral Dissertation: Nijmegen University, Netherlands).

Oyedeji, O. A. (1994). Effect of the use of formative evaluation on some cognitive and non-cognitive student learning outcomes in secondary mathematics. *Studies in Educational Evaluation, 20*(2) 223-225.

Ozcan, M. (1996). *Improving teacher performance: Toward a theory of teacher motivation*. U.S.; Iowa: September 23, 2006, from ERIC database.

Ozgun-Koca, S. A. (2001). *The effects of multiple linked representations on student learning in mathematics* ERIC/CSMEE Publications, 1929 Kenny Road, Columbus, OH 43210-1080. Tel: 800-276-0462 (Toll Free); Tel: 614-292-5680. June 16, 2007, from ERIC database.

Pierson, M. (2001). Technology practice as a function of pedagogical expertise. *Journal of Research on Computing on Education*, 33(4), 413-430.

RAND Mathematics Study Panel [RAND MSP]. (2003). *Mathematical proficiency for all students: Towards a strategic development program in mathematics education.* Santa Monica, CA: RAND Corporation MR-1643.0-OERI.Reynolds, D., & Muijs, D. (1999). The effective teaching of mathematics: A review of research. *School Leadership & Management, 19*(3), 273-288.

Remillard, J. (1996). *Changing Texts, Teachers, and Teaching: The Role of Curriculum Materials in Mathematics Education Reform*. (Doctoral dissertation, Michigan State University).

Remillard, J. (2005). Examining key concepts in research on teachers' use of mathematics curricula. *Review of Educational Research, 75*(2), 211-246.

Remillard, J.T., & Bryans, M.B. (2004). Teachers; orientations toward mathematics curriculum materials: Implications for teacher learning. *Journal for Research in Mathematics Education, 35*, 352-388.

Shepard, L. A., & and Others. (1996). Effects of introducing classroom performance assessments on student learning. *Educational Measurement: Issues and Practice, 15*(3) 7-18.

Schoenfeld, A. (1985). *Mathematical problem solving*. New York, NY: Academic Press.

Schoenfeld, A. (1992). Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics. In D.A. Grouws (Eds.), *Handbook for research on mathematics teaching and learning* (pp. 334-370). New York: Macmillan.

Scribner, J. P. (1999). Professional development: Untangling the influence of work context on teacher learning. *Educational Administration Quarterly, 35*(2) 238-266.

Shulman, L.S. (1987). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15* (2), 4-14.

Shulman, S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*, 4-14.

Shulman, L.S., & Shulman, J.H. (2004). How and what teachers learn: a shifting perspective. *Curriculum Studies, 36*(2), 257-271.

Sherin, M.G. (2002). When teaching becomes learning. *Cognition and Instruction, 20*(2), 119–150.

Smylie, M. A. (1988). The enhancement function of staff development: Organizational and psychological antecedents to individual teacher change. *American Educational Research Journal, 25*, 1–30.

Sowder, J. (2007). The mathematical education and development of teachers. In F.K. Lester (Eds.), *Second handbook of research on mathematics teaching and learning* (pp. 157-225). Charlotte, NC: Information Age Publishing.

Stump, S. (1997). *Secondary mathematics teachers' knowledge of the concept of slope.* Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, 1997).

Tamir, P. (1987). *Subject matter and related pedagogical knowledge in teacher education.* Paper presented at the annual meeting of the American Association for Education Research, Washington, D.C.

Usuki, M. (2001). *The learning process model and autonomy* June 22, 2007, from ERIC database.

Van Eekelen, I.M., Vermint, J.D., & Boshuizen, H.P.A. (2006). Exploring teachers' will to learn. *Teaching and Teacher Education, 22*, 408-423.

van den Berg, R., & Ross, A. (1999). The Permanent Importance of the Subjective Reality of Teachers During Educational Innovation: A Concerns-Based Approach. *American Educational Research Journal, 36* (4), 879-906.

Vermunt, J.D. (1996). Metacognitive, cognitive, and affective aspects of learning styles and strategies: A phenomenographic analysis. *Higher Education, 31,* 25-50.

Vygotsky, L. (1978*). Mind in society.* Boston, MA: Harvard University Press.

Wagner, T. (2001). Leadership for learning: An action theory of school change. *Phi Delta Kappan, 82*(5) 378-383.

Woodbridge, J. (2004). *Technology Integration as a Teaching Strategy*. Paper presented at the National Educational Computing Conference, New Orleans, LA.

Woolfolk, A. E., & Hoy, W. K. (1990). Prospective teachers' sense of efficacy and beliefs about control. *Journal of Educational Psychology, 82*(1), 81–91.

Zimmerman, B. (2002). *Achieving Self-Regulation: The Trial and Triumph of Adolescence*. ERIC (ED471681)

VITA

Aina K. Appova, is a middle daughter (of three) of Emma & Kakabay. She was born in Ashgabat, Turkmenistan in 1979. She graduated from high school in 1995 and earned her Bachelor's Degree in 1999. From 1994 to 1995, Aina also visited the USA as an exchange student in Adrian, Michigan. The wonderful Morgret family hosted her. They treated her like their own daughter and continue to look out for her.

After finishing her Bachelor's degree in Economics, Aina decided to pursue a graduate degree in Mathematics. In 2004 she successfully completed her Master's degree in Mathematics (MAT) and was accepted to the Mathematics Education doctoral program at the University of Missouri - Columbia.

In August 2009, Aina successfully defended her dissertation and completed the degree requirements for her Ph.D. in Mathematics Education. She also accepted her Assistant Professor position at Wright State University, as a joint faculty between the Department of Mathematics and Statistics and the Department of Teacher Education.

Aina is proud of her achievements and is grateful to everyone who has helped and encouraged her throughout her life, and the difficult years of graduate school. It has truly been a rewarding life experience.