UNDERSTANDING TEACHER PROFESSIONAL DEVELOPMENT FOR URBAN AND SUBURBAN HIGH SCHOOL MATHEMATICS TEACHERS

by

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DEDICATION

To my beautiful parents:

Cecil Timothy St. Clair

and

Estella January St. Clair

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CHAPTER 1

INTRODUCTION

One of American education's most formidable challenges concerns closing the achievement gap in mathematics along racial and income lines (Goldberger & Bayerl, 2008, Executive Summary section, para. 1). Although recent studies have indicated that the achievement gap in mathematics is narrowing along racial lines, Asian/Pacific Islander and Caucasian students continue to perform substantially higher on tests which measure achievement in mathematics than African Americans (Thomas, 1999, p. 4). In fact, African Americans have made the least amount of academic gains among any other major ethnic minority group in the United States (Thomas, 1999, p. 4). Further, in 2007, a Council of Great City Schools study found that students in urban school districts who were most likely to be African American, Hispanic, or Asian American (79% of students in Great City Schools were in these ethnic categories in 2005-06) and from low income families (64% of students in the Great City Schools are eligible for a federal free or reduced price lunch subsidy) performed below state averages in fourth and eighth grade mathematics (Council of Great City Schools, 2008, pp. iv-v).

Viewed from a national perspective, these findings are particularly alarming. This is due to the fact that birth rates among minority populations such as African Americans typically exceed those of other minority groups and poor performance in mathematics would negatively impact both the quality and quantity of human resources within the United States (National Mathematics Advisory Panel, 2008, p. xii and Thomas, 1999, pp. 4 - 5). Failing to improve the performance of any ethnic group in the area of mathematics and science "could seriously jeopardize the availability of human resources and subsequently hamper the economic advancement and competitiveness of the United States" (Thomas, 1999, pp. 4 - 5). Additionally,

such a gap leaves important groups on society's margins with inadequate economic viability (MacLeod, 2004).

To tame the devastating effects of the mathematics achievement gap along racial and income lines, some have suggested that this gap can be significantly lowered and possibly eliminated altogether if minority and low income students experience success in their high school mathematics courses (Evan et al. cited in National Mathematics Advisory Panel, 2008, p. 5). More specifically, success in Algebra I has often been referred to as a "fork in the road — a decision point where one direction leads to opportunities and the other direction leads to limited options for education and career choices" (Taylor cited in Wright, 2008, para. 4). In fact, students who complete Algebra II are "more than twice as likely to graduate from college compared to students with less mathematical preparation" (National Mathematics Advisory Panel, 2008, p. xiii). Clearly, successful achievement in high school mathematics, particularly algebra, is critical for strong academic and prosperous employment futures among our youth, especially those from minority populations such as African Americans.

However, "substantial differences in the mathematics achievement of students are attributable to differences in teachers" (National Mathematics Advisory Panel, 2008, p. 35). Further, "achievement gains from having an effective teacher could be almost three times as large for African American students than for white students, when comparing students with the same prior school achievement" (Sanders & Rivers cited in The Center for Public Education, 2005a, para. 4). This brings us to a discussion of teacher quality and its relationship to student achievement.

Teacher Quality and Student Achievement

"Teacher quality matters. In fact it is the most important school-related factor influencing student achievement" (Rice, 2003, p. v). More than twenty years of research studies support the contention that teacher quality matters (The Center for Public Education, 2005b, para. 4). For example, 42% of the variation in student achievement can be explained by teacher qualifications, almost twice the next closest variables of parental education and income levels (National Staff Development Council, 1997, p. 7).

Yet, when it comes to districts serving lower income and minority populations, teacher quality and teacher qualifications become especially important issues. For instance, "poor and minority students were about twice as likely to have teachers with less than three years of teaching experience; and districts in which the majority of students were poor or minority were considerably more likely to employ uncertified teachers" (National Center for Education Statistics cited in The Center for Public Education, 2005a, para. 16; Darling-Hammond cited in The Center for Public Education, 2005a, para. 16). Further, in her ethnography of eight female teachers' classrooms (five African American and three White), Ladson-Billings (1994) noted that "many teachers – white and black alike – feel ill-prepared for or incapable of meeting the educational needs of African American students" (p. x). In what follows, teacher preparation as a method to improve teacher quality is further detailed through a discussion of teacher professional development and it relationship to teacher quality.

Teacher Quality and Teacher Professional Development

There is increasing agreement among scholars that effective teacher professional development can improve teacher quality (The Center for Public Education, 2005c, p. 5). Effective teacher professional development "results in improvements in teachers' knowledge and

instructional practice as well as improved student learning outcomes" (Wei, Darling-Hammond, Andree, Richardson & Orphanos, 2009, p. 3). Additionally, scholarship encourages policymakers at state and local levels to support teacher professional development in efforts to improve teacher quality (Learning Point Associates, 2005, p. 5). For example, the National Mathematics Advisory Panel advised that efforts should be directed toward improving teacher preparation, mentoring and ongoing teacher professional development for mathematics teachers at all levels with special attention to improving their content knowledge (National Mathematics Advisory Panel, 2008, p. 40). Additionally, scholarship supports teacher professional development that is more collaborative, sustained, and occurs as a natural part of a teacher's work day (Darling-Hammond cited in Nealy, 2009, para. 3).

Research Purpose

Since teacher quality has been found to be critical in improving student learning, and teacher professional development is recommended by scholars as a strategic approach to improve teacher quality through the improvement of teacher practice, the purpose of this research is to study the professional development experiences of four teachers. Noting the differences in mathematics achievement among African American students and Caucasian students, this study focuses on the professional development experiences of four high school mathematics teachers – two who taught in urban, public school districts serving predominately African American students and two who taught in a suburban, parochial school. By parochial, I mean a state designation closely associated with and operated by a religious organization and paid for outside of public funds. This definition will be adopted throughout this dissertation.

For the purposes of this dissertation, by "teacher professional development" I mean a long-standing group of professional learning activities that are usually arrived at based on

conversations between administrators and teachers about student learning through teacher learning. Teacher professional development is the larger set of strategies for improving teacher capabilities of teaching, which is often, but not always, a matter of public teacher contracts. Teacher compliance is expected and compensated. A professional learning community is responsive to the research on teacher professional development and is a subset or movement within the historical, traditional definition of teacher professional development. A professional learning community is a particular form of teacher professional development that seriously takes into account concepts and practices known to be associated with effective teacher professional development. In what follows in chapters 2 and 3, a framework is established for guiding this research and developing methodological strategies, respectively.

CHAPTER 2

SCHOLARLY FRAMEWORK

Teacher professional development does not occur in isolation, but is situated in schools and districts, as well as influenced by research about teacher professional development practices. Here, I develop a framework to guide this research. As argued in what follows, the teacher professional development experiences of the four teachers in this study appear on the surface to exhibit practices closely associated with those of a professional learning community, which is a form of teacher professional development likely to remain true to research findings about effective teacher professional development. However to decontextualize teacher professional development and ignore the ways school and district histories (past practices) influence teacher professional development risks developing only a partial understanding of the teacher professional development experiences currently underway. Thus, this chapter will begin with school and district influences, move to a discussion of teacher professional development practices, outline the criteria for a professional learning community, and ultimately justify the teacher professional development in this research as one that is worth study and investigation.

School and District Influences on Teacher Professional Development

Given that teacher professional development promotes student achievement, what might contribute in turn to promoting teacher professional development? School organization and culture remains one of the greater contributions to teacher professional development success (Halley & Valli, 1999; Sykes, 1999; Sparks & Loucks-Horsley, 1990; Abdal-Haqq, 1996). As Abdal-Haqq (1996) wrote over a decade ago:

It is a culture that does not place a premium on teacher learning and in which decisions about professional development are not usually made by teachers but by state, district,

and building administrators. Paradoxically, implementing a more effective pattern of teacher professional development requires struggling against these constraints, but it may also help to create a school climate that is more hospitable to teacher learning. (p. 4)

As discussed below, schools and districts differ in how much teacher professional development is stressed in their organizations, teacher professional development is situational or possesses a contextual nature, and there are various organizational, structural, and cultural factors which influence teacher professional development.

Schools vary in the amount of emphasis they place on teacher professional development as a result of their organization and culture (Sykes, 1999 p. 156). This variance among schools may explain why some schools possess a more collaborative or collegial nature with respect to teacher professional development than others (Sykes, 1999, p. 157). For example, some schools may be more apt than others to "involve participants in decision-making and [to] hold members of the school community to shared ideals, standards, norms, and values" (Sykes, 1999, p. 157).

Teacher professional development may be viewed as situational or contextual in nature because it is dependent upon certain features and characteristics which may exist only within some organization (Sparks & Loucks-Horsley, 1990, p. 247). Likewise, "teacher professional development in school districts does not take place in a vacuum. Its success is influenced in many ways by the districts' organizational context" (McLaughlin & Marsh cited in Sparks & Loucks-Horsley, 1990, p. 244). Further, teachers' reactions and responses to teacher professional development offerings are influenced by existing norms, traditions, and social relationships within the organization (Sykes, 1999, p. 157). Scholarship suggests that schools should be structured as "learning organizations" where students, teachers, and administrators collectively

work together to cultivate group norms and professional values which support continuous teacher learning (Hawley & Valli, 1999, p. 144).

Finally, there are specific organizational, cultural, and structural factors influencing teacher professional development (Sykes, 1999 p. 170). For example, "key organizational factors include school and district climate, leadership attitudes and behaviors, district policies and systems, and involvement of participants" (Sparks & Loucks-Horsley, 1990, p. 244). Further, administrators at both the school and central levels should support and commit to teacher learning that emphasizes changes in curricular and instructional practices with improved student achievement as the ultimate goal (Sparks & Loucks-Horsley, 1990, p. 247). In terms of cultural factors influencing teacher professional development, schools should foster norms that support collegiality and experimentation in an atmosphere where experimentation in teacher professional development without penalty is encouraged (Sparks & Loucks-Horsley, 1990, p. 245). Lastly, schools need to be structured in ways which provide teachers with opportunities to learn in individual and group situations, to receive and give assistance, to reflect upon the learnings, and to collaborate about student learning and student performance (Hawley & Valli, 1999, p. 144; Sparks & Loucks-Horsley, 1990, p. 247).

Several studies suggest that schools and districts have not been organized effectively to support teacher professional development (Cohen & Spillane; Miller, Lord & Dorney; Moore & Hyde; Fernstermacher & Berliner; Schlecty & Whitford cited in Sykes, 1999, pp. 134, 152, 160). In fact, the overall organization of teacher professional development in schools and districts has been described as "fragmented" and "shallow," especially in large urban school districts (Cohen & Spillane; Miller, Lord & Dorney; Moore & Hyde; Fernstermacher & Berliner; Schlecty & Whitford cited in Sykes, 1999, pp. 134, 152, 160). One of the reasons for this fragmentation is

that "funding personnel and authority tend to be spread across offices and [to be] poorly coordinated with any set of stable priorities" (Sykes, 1999, p. 160). This fragmentation of teacher professional development is often characterized by brief workshops, where overall levels of importance vary across schools and districts (Sykes, 1999, p. 160).

The fragmented organization of teacher professional development negatively impacts teachers' opportunities to learn, teachers' instructional practice, and student learning (Hawley & Valli, 1999; Sykes, 1999). In fact, there is "virtually unanimous agreement that educators' opportunities to learn are usually infrequent, poorly designed and inadequately delivered" (Hawley & Valli, 1999, pp. 136-137). Even more disturbing, the fragmented organization of teacher professional development which often lends itself to brief workshops has led to "no significant change in practice when teachers returned to their classrooms" (Fullan cited in Hawley & Valli, 1999, p. 134). As a result, teacher professional development that is not effectively organized at school or district levels provides little evidence that it improves student learning through teacher learning (Sykes, 1999, p. 159). Thus, scholarship recommends a stronger relationship between teacher learning and student learning (Sykes, 1999, p. 151), a point I return to in a subsequent section.

Another factor that underpins the organization and culture of schools and districts with respect to teacher professional development is the provision of time. Teachers need time to learn new strategies, to practice, and to reflect upon teacher professional development opportunities (Cambone; Corcoran; Troen & Bolles; Watts & Castle cited in Abdal-Haqq, 1996, p. 2 and Hodges cited in Hawley & Valli, 1999, p. 144). Teachers also need time and opportunities to collaborate with their peers regarding new instructional strategies and assess which strategies are more effective with students than others (Hawley & Valli, 1999; Sparks, 2001).

The educational community agrees that the provision of time is one of the greatest challenges to implement effective teacher professional development (Cambone; Corcoran; Troen & Bolles; Watts & Castle cited in Abdal-Haqq, 1996, p. 2). Some strategies to enhance the provision of time for teacher professional development include: extending the school day or year, implementing block scheduling, incorporating regularly scheduled early release days, utilizing regular staff or district meetings for teacher professional development, instituting common teacher preparation periods, reducing non-teaching duties of staff, and organizing purchased time to begin a substitute bank so that teachers can use when they participate in teacher professional development (Watts & Castle; Tanner, Canady and Rettig cited in Abdal-Haqq, 1996, p. 4; Sparks & Hirsh, 2000; Sparks, 2001). Also, the National Staff Development Council "recommends that states and districts increase to 25% the time available during the school day for teachers to work together and collaboratively plan lessons and share information" (Sparks & Hirsh, 2000, p. 13). This provision of time allocated during the school day points toward the concept of teacher professional development as being job-embedded. I return to a discussion of this concept in the next section.

Even though teacher professional development has been viewed as fragmented organizationally and time for teacher professional development has not been adequately allocated in schools and districts, administrators can positively influence the organization and culture of schools and districts where teacher professional development occurs (Deal & Peterson, cited in Guskey & Sparks, 1996, p. 4; Conley & Bacharach cited in Sparks & Loucks-Horsley, 1990, p. 245). As Deal and Peterson (1994) emphasized, "Administrators can do much to establish the climate or culture of a school by modeling high standards of professional behavior and by ensuring the school is a true learning community that supports experimentation and

values efforts to improve" (Deal & Peterson cited in Guskey & Sparks, 1996, p. 4). In fact, some studies suggest that teachers improved most and changes lasted longer when principals supported them and were actually involved in the teacher professional development (Fielding & Shalock cited in Sparks & Loucks-Horsley, 1990; p. 245; Stallings & Mohlman cited in Sparks & Loucks-Horsley, 1990, p. 245). Additionally, staff development is most successful in organizations where administrators use their leadership to promote norms of collaboration and collegiality, stress the importance of continuous teacher learning, and monitor progress toward goals (Sparks & Loucks Horsley, 1990, p. 245).

In addition to internal supports such as those offered by administrators, teacher professional development requires on-going, continuous support from external sources (Fullan; Guskey; Hodges; Miller, Lord & Dorney; NCRTE; NEA, 1995; Pink & Hyde cited in Hawley & Valli, 1999, p. 141). In fact, without internal and external supports to assist teachers in their use of instructional strategies and reflection on practice, most teachers cannot make significant changes regardless of their focus and commitment (Joyce & Showers cited in Hawley & Valli, 1999, p. 131). Ultimately, what is required is the creation of an organizational context that:

> …orchestrates a range of linked activities over time that combine internal work with external consultations. Such work is school and classroom centered while connecting with outside sources of expertise. Teachers play a central role, but district and school administrators can be critical in establishing and supporting the process. (Sykes, 1999, p.174)

Not only are the internal and external supports received by teachers important in positively affecting the organization and culture of schools and districts where teacher professional development occurs, but teachers' beliefs about teacher learning and student learning prove just

as critical. In fact, teacher professional development is most effective when it addresses and engages teachers' beliefs (Hawley & Valli, 1999; Sparks & Hirsh, 2000; Sykes, 1999). Further, teacher professional development often fails when it does not acknowledge and engage the beliefs and personal identities of teachers (Hargreaves cited in Hawley & Valli, 1999, p. 133). Thus, teacher professional development opportunities "must account for educators' extant knowledge and beliefs, develop reflective capacities, attend to motivational and developmental issues and build upon social relations in the school context" (Hawley & Valli, 1999, p. 137).

Teacher professional development can acknowledge and engage teachers' beliefs by encouraging staff to embrace and maintain beliefs and attitudes that all students are capable of learning at high levels (Sparks & Hirsh, 2000, p. 3). In fact, teacher professional development is most successful in organizations where staff collectively develop goals and objectives which reflect high expectations for both teachers and students (Sparks & Loucks-Horsley, 1990, p. 245). Further, teachers' attitudes and beliefs "change in a significant way" when they can actually see that a new program or instructional practice improves or enhances student learning (Sparks & Loucks-Horsley, 1990, p. 245).

In summary, there are organizational and cultural factors in schools and districts which influence teacher professional development such as the provision of time for professional learning, support and leadership of school and district administrators, ongoing external supports, and teachers' beliefs about teacher learning and student learning. Fieldwork reconnaissance suggests that the teacher professional development in this research occurs in settings where such organizational and cultural factors exist. For example, during the last academic year, mathematics teachers at one of the schools regularly met with one another during common planning periods to collaborate about their learning and plan lessons. These meetings were

supplemented with ongoing sessions conducted by external support sources of the teacher professional development. Further, administrators at the school and central levels demonstrated a commitment to improved instructional practices when, for example, substitutes were paid and provided for by an external source so that teachers would have time and opportunity to attend teacher professional development sessions. This information began to raise questions about additional organizational and cultural structures which may exist in this research, how teacher professional development is best described in light of these organizational and cultural structures, and to what extent and how these structures influence the teacher professional development that will be studied.

<div align="center">Goals of Teacher Professional Development Practices</div>

In addition to organizational and cultural structures, which support high expectations for teacher learning and student learning, teacher professional development promises to improve teacher learning in order to accomplish its primary goal of improved student learning and achievement (Sparks & Loucks-Horsely, 1990; Lowden, 2005; Shaha, Lewis, O'Donnell, & Brown, 2004; Hawley & Valli, 1999). This goal not only features improved student learning, but also the accomplishment of learning at high levels for all students (Lowden, 2005, p. 2). In fact, according to NSDC, the primary purpose of staff development is to "ensure high levels of learning for all students through improved professional learning experiences for every school employee who affects student learning" (Sparks, 2001, p. 1).

On the path to improved student learning at high levels, teacher professional development aims to improve the "knowledge, skills, attitudes, and beliefs" of educators (Guskey cited in Lowden, 2005, p. 2). For example, Shaha (2004) maintained that:

Professional development programs were intended to equip teachers with new or redefined skills and techniques for achieving better results for their students and for helping teachers themselves to be more confident, capable, and fulfilled…Bottom line, the purpose of professional development is to help teachers be better teachers. (p. 1).

Such improved teacher learning without improved student learning would indeed characterize an empty promise of teacher professional development. Therefore, understanding teacher learning may be best understood by acknowledging and understanding its relationship to student learning. This relationship can be described by explaining four aspects of teacher learning and student learning as they relate to teacher professional development: 1) the alignment of teacher learning to student learning; 2) the theoretical understanding and subject area knowledge as a component of teacher learning; 3) the job-embedded nature of teacher learning; and 4) the enhancement and improvement of student learning.

In terms of aligning teacher learning to student learning in teacher professional development, the most important foci of teacher learning should be student learning and the content of student learning (Sykes, 1999, p. 176). Some suggest "embedding" teacher professional development in the content of the student curriculum. (Sykes, 1999, p. 161). Further, schools and districts have been called upon to utilize professional activities of teachers as optimal opportunities to enhance teacher learning "in conjunction with targeted work related to their students' learning" (Sykes, 1999, p. 173). One example of a professional activity which could be used toward this end is for teachers to work collaboratively in teams to design supporting materials for new texts while concentrating on students' understanding of certain concepts (Sykes, 1999, p. 173). Thus, the knowledge that students are expected to attain is critical in the design and implementation of teacher professional development.

As attention to the content of student learning is targeted in the design and implementation of teacher professional development, the theoretical understanding and subject area knowledge of teachers become major components of teacher learning. In fact, there is a growing body of research which highlights the idea that the improvement of teachers' subject area knowledge as well as their pedagogical skills is critical to improving student achievement (Sparks & Hirsh, 2000, p. 2). Further, "when teachers have significant opportunity to learn the content that their students will study, in ways that seem to enable them to learn more about that material…teachers' opportunities to learn pay off in their students' performance" (Cohen & Hill, cited in Sykes, 1999, p. 164). Thus, teachers must have a thorough, deep, and flexible understanding of the subject matter in order to assist students in relating concepts to one another (Darling-Hammond, 1998, p. 6). Disregarding ways that help teachers' to develop their theoretical understanding and subject area knowledge risks ignoring the "critical link between student performance and teaching" (Sparks & Hirsh, 2000, p. 2).

Not only does scholarship agree that teacher learning must be aligned to student learning and that a major component of this teacher learning should include and improve the content area knowledge of teachers, researchers maintain that this content knowledge should be advanced, complex, and rigorous (Sykes, 1999; Sparks & Hirsh, 2000). Sparks and Hirsh (2000) emphasized the importance surrounding the complexity of teachers' content knowledge through teacher professional development in the following excerpt:

> Staff development helps prepare teachers for the complexities of educating the millennial generation with the advanced skills and knowledge they will need for the unknown future…it helps teachers enhance their knowledge of content so they are better able to answer students' questions, enliven lessons, and help students solve problems. (p. 3)

Further, teacher professional development can be a "significant contributor to what students learn if it was more directly linked to students' mastery of complex knowledge…" (Hawley & Valli, 1999, p. 132). Future teachers are expected to need far more advanced forms of practice than in any prior generation (Sykes, 1999, p. 153). Thus, as the expectations of students to achieve higher standards and levels of performance increase, teacher professional development must meet these demands by providing opportunities for teachers to master complex theoretical content in order to prepare students to be successful in an ever-changing world.

The third aspect that helps to define and describe the relationship between teacher learning and student learning is the job-embedded nature of teacher learning. Teacher professional development should occur as a natural part of teachers' daily work (Sykes, 1999; Sparks & Hirsh, 2000; NSDC, 2006; NSDC, 2007). Teacher professional development that is job embedded is supported by NSDC's goal and mission for teacher professional development which is that "all teachers in all schools will experience high quality professional learning as part of their daily work" (NSDC, 2006) and "every educator engages in effective professional learning every day so that every student achieves" (NSDC, 2007). Job-embedded teacher professional development is not only advised by scholars, but is described as being the "optimal" form of work environment "in which learning arises from and feeds back into work experience, where learning is part of work" (Smylie cited in Hawley & Valli, 1999, p. 140).

The primary goal of teacher professional development is the improvement of student learning, the last aspect describing the relationship between teacher learning and student learning. Teacher professional development is "essential to improving the capability of schools to enhance student learning" (Hawley & Valli, 1999, p. 129) and "teacher learning is essential to improved student learning" (Hawley & Valli, 1999, p. 131). How is teacher learning that

improves student learning best accomplished? A synthesis of the research on effective teacher professional development revealed "eight design principles [which] focus attention on professional development strategies that appear to be essential to improving students' learning over time" (Hawley & Valli, 1999, pp. 137-138):

1. Driven, fundamentally, by analyses of the differences between (1) goals and standards for learning and (2) student performance.

2. Involves learners (such as teachers) in the identification of their learning needs and, when possible, the development of the learning opportunity and/or the process to be used.

3. Is primarily school based and integral to school operations.

4. Provides learning opportunities that relate to individual needs but for the most part are organized around collaborative problem solving.

5. Is continuous and ongoing, involving follow-up and support for further learning including support from sources external to the school.

6. Incorporates evaluation of multiple sources of information on outcomes for student and processes involved in implementing the lessons learned through professional development.

7. Provides opportunities to develop a theoretical understanding of the knowledge and skills to be learned.

8. Is integrated with a comprehensive change process that deals with the full range of impediments to and facilitators of student learning. (p. 138)

Additional characteristics and strategies for effective teacher professional development will be further detailed in the next section.

Ultimately, teacher learning is inextricably connected to student learning, the primary goal of teacher professional development. Similarly, student learning should play a greater role in decisions about teacher professional development, a concept suggested by Sykes (1999):

One means for introducing greater discipline into the process of implementation [of teacher professional development] is to build in more attention to effects on student learning as a means to improve the process and test the program or innovation itself...[and] an important agenda for the future, therefore, is to strengthen the relationship between teacher and learning. (pp. 151, 168)

In fact, NSDC asserts that "student outcomes should provide the starting point for all school improvement and staff development efforts" (Guskey & Sparks, 1996, p. 6).

Changes Associated with Teacher Professional Development

As teacher professional development's primary of goal of improved student achievement is accomplished, there are three major types of changes which can reasonably be expected to occur: changes in teacher practice, systemic or comprehensive change within a school district, and educational change or school improvement. Taking teacher practice first:

[As] the change literature reveals, many career teachers depart during certain stages of their work lives from the model of stable, gradually evolving practice to experiment with potentially transformative or revolutionary practices. These episodes have variable results. Teachers may transform their practices over time, or they may change the innovation to fit their existing practices over time (a process described as mutual adaptation in the early change literature), or the experiment may end in disillusionment and withdrawal from further adventures. (Sykes, 1999, p. 157)

Another important finding with respect to changes in teacher practice was realized from the results of a survey study on the professional development of teachers in California. Change in teacher practices among mathematics teachers occurred when teachers were provided with "even more concrete topic-specific learning opportunities" (Cohen & Hill cited in Sykes, 1999, p. 164). This finding highlights the importance of changes in teacher practice as well as teachers' knowledge of the subject area which was explained in the previous section on the relationship between teacher learning and student learning.

Huberman (1995) offered another perspective on changes in teacher practice when he suggested the following:

> If innovations are to effect changes in teacher practice, then teachers must participate in cycles of activity that combine the collective work internal to the school with interactions outside the school that supply conceptual inputs, technical consultants, observations and demonstrations and other resources. (Huberman cited in Sykes, 1999, p. 174)

As referenced in a previous section, we again see the importance of external supports and resources for teacher professional development. Additionally, teacher professional development should be viewed as "cycles of activity" or possessing a cyclical nature. As will be detailed in Chapter 3, this study provides understanding and description of teacher professional development from the perspective that it is a cyclical and an on-going process to improve student learning through the enhancement of teacher learning.

Regarding systemic or comprehensive change within a school district, a national, longitudinal study investigating the relationship between teacher professional development and changes in teaching practices revealed that: little changed in overall teaching practice from 1996 to 1999, individual teachers varied in their classroom practices, and moderate variation occurred

in the classroom practice of individual teachers from year to year, professional development focused on a higher-order teaching strategy result in teachers' increasing their use of this strategy in the classroom, and overall, the positive effects of professional development on teaching practice would be increased if districts and schools provided a more coherent, systemic program of high-quality professional development for their teachers (United States Department of Education, 2000, Executive Summary). The last finding from this study challenged districts and schools to provide a "more coherent, systemic program" of teacher professional development, something echoed by other researchers who call for a more systemic approach to teacher professional development (Guskey & Sparks, 1996, p. 5). Ultimately, NCLB legislation "requires states and local districts to plan systemically for professional learning…" (Lowden, 2005, p. 2).

Other critical elements identified by scholarship as being critical to achieving comprehensive change at district and school levels with respect to teacher professional development include: adequate funding, technical support, consistent central office support and follow-through, adequate time for teachers to learn and practice new skills, and the avoidance of short-term fixes (Hodges cited in Hawley & Valli, 1999, p.144). Some even advise to "think[ing] big (have a comprehensive) plan but start[ing] small (approaching change in a gradual incremental manner)" (Guskey cited in Hawley & Valli, 1999, pp. 143-144). Ultimately, the extant literature agrees that "professional development should be integrated with a comprehensive change process that deals with impediments to and facilitators of student learning" (Hawley & Valli, 1999, p. 143).

School improvement is the third target for change related to teacher professional development. Major educational consortiums and associations such as the Consortium on

Productivity in Schools, the National Commission on Teaching and America's Future, and the National Education Association all agreed with the conclusion from the American Federation of Teachers in 1995 that school reform cannot occur without teacher professional development. (Hawley & Valli, 1999, p. 129). Hence, "the logic of investing in professional development, then, is straightforward: there is no more effective way to change schools substantially" (Hawley & Valli, 1999, p. 129).

School improvement requires teacher professional development that is job embedded, a concept discussed in the previous section on the relationship between teacher learning and student learning. Some argue that school improvement will fail unless the "importance of schools not only as places to work but also as places for teachers to learn" is acknowledged (Smylie cited in Hawley & Valli, 1999, p. 129). Further, "school improvement cannot occur apart from a closely connected culture of professional development" (Hawley & Valli, 1999, p. 129). Thus, we again see the necessity of a culture which values daily professional learning as the optimal vehicle for school improvement and educational change to occur.

In summary, teacher professional development practices regarding teacher learning, student learning, and changes associated with teacher professional development are guided by the primary goal of teacher professional development which is to improve and enhance student learning through teacher learning. This research offers an opportunity to explore these concepts depth through descriptions and analysis of teacher participants professional development experiences. It was discussed earlier that minority groups such as African Americans have historically not performed as well on mathematics achievement tests as Caucasian and Asian/Pacific Islander students. Thus, the selection of these particular research sites adds practical significance in that they lend insight into teacher learning as it relates to mathematics in

both a predominately African American, urban school district and a predominately, Caucasian suburban school district, while at the same time allowing investigation of questions such as: What is the relationship between teacher learning and student learning in the proposed research? What changes related to teacher practice and student learning occur as teacher professional development is implemented in the proposed research?

Effective Teacher Professional Development

As referenced earlier, effective teacher professional development "results in improvements in teachers' knowledge and instructional practice as well as improved student learning outcomes" (Wei, Darling-Hammond, Andree, Richardson, & Orphanos, 2009, p. 3). What specific features and characteristics of teacher professional development accomplish improved teacher knowledge, practice, and student learning? Research studies regarding the effectiveness of teacher professional development suggest many descriptions of what teacher learning and student learning should look like at school and district levels of implementation. Additionally, professional organizations such as the National Council for Teachers of Mathematics (NCTM) recommend strategies and approaches for successful mathematics teacher professional development. Table 1 organizes these descriptions according to teacher professional development in general, teacher professional development that is focused in the area of mathematics, teacher professional development that impacts teacher practice, and teacher professional development that improves student learning.

Table 1. Characteristics, Strategies, and Approaches for Effective TPD

Characteristic, Strategy, Approach to Teacher Professional Development	General Teacher Professional Development [1,2]	Teacher Professional Development Related to Mathematics [3]	Teacher Professional Development that Impacts Teacher Practice [4]	Teacher Professional Development that Improves Student Learning [5]
Focuses on the theoretical understandings and knowledge of the subject matter	X	X	X	X
Continuous and ongoing	X	X	X	X
Sustained and includes resources for follow-up support	X	X	X	X
Makes use of teachers' knowledge and expertise	X	X		
Encourages collaboration and collegiality among teachers	X	X	X	X
Acknowledges the nature of learning and that learning requires change	X			X
Includes evaluation of efforts that incorporates multiple sources of data				X
Analyzes data related to student learning and performance	X		X	X
Organizes adults into professional learning communities			X	X
Incorporates effective instructional strategies			X	X
Takes into account participants' existing beliefs	X	X		X
Has administrative support	X			X
Includes information on how to appropriately involve parents and the community				X
Is integrated schoolwide	X		X	

Adapted from:
[1] Richardson, 2003
[2] Hawley & Valli,1999
[3] Smith, 2001
[4] NSDC, 2009
[5] NSDC, 2001

Table 1 reveals similarities as well as differences with regard to what comprises effective teacher professional development according to scholarship and professional organizations across the varying types of teacher professional development represented in the table. Examples of similarities among teacher professional development characteristics across the various types of teacher professional development represented in the table are the focus on theoretical understandings of the subject matter, collaboration and collegiality among teachers, continuity, and follow-up support with resources. Thus, all of these strategies and approaches have been referenced as being critical to teacher professional development in general, mathematics teacher professional development, teacher professional development that impacts practice, and teacher professional development that impact student learning. An example of a difference as illustrated in Table 1 concerns the characteristic of teacher professional development being integrated schoolwide. This characteristic is referenced under general teacher professional development and teacher professional development that impacts practice; however it is not referenced as it relates to mathematics teacher professional development and teacher professional development that impacts student learning. Information from this table will be used to further understand the teacher professional development that occurs in the proposed research.

In 2001, NSDC organized many of these research-based strategies and characteristics of effective teacher professional development in the form of twelve standards for professional learning. NSDC's standards for teacher professional development are arranged into three categories: context, process, and content. The context standards refer to the organization and structures in which the teacher professional development will take place. The process standards refer to how teacher professional development should be implemented. Content standards refer to "what" information and knowledge the teacher professional programs and activities will

contain (NSDC, 2001, p. 2). NSDC emphasizes that "context, process, and content standards are all necessary to ensure that staff development improves student learning. If one is ignored, the intended results are far less likely to be achieved" (NSDC, 2001, p. 2). Thus, there is an interdependent relationship among the standards of teacher professional development and all are required for teacher professional development to accomplish its primary goal of improved student learning. Table 2 displays NSDC's Standards for Staff Development. All standards are prefaced with the phrase: **"***Staff development that improves the learning of all students…"*** (NSDC, 2001, p. 5).

Table 2. NSDC's Standards for Staff Development

Context	Process	Content
Staff development that improves the learning of all students…		
Organizes adults into learning communities whose goals are aligned to those of the school and district	Uses data to inform instructional decisions	Provides information on how to appropriately involve parents and the community
Requires skillful district and school leaders who encourage collegiality	Has evaluation that uses multiple sources of information to guide improvement	Provides information in terms of creating safe and supportive environments for all children and fostering high expectations for all children
Has resources to support and sustain continuous improvement	Provides information on how to design the content of professional development and provides knowledge of effective instructional strategies and practices	Deepens the theoretical subject area knowledge, provides information about effective research-based instructional strategies as well as information on how to utilize classroom assessments
	Provides information on human learning and change	
	Provides knowledge on what the research-based instructional strategies are and how to implement these strategies in classrooms	
	Provides information and knowledge in terms of how to collaborate	

Adopted from NSDC, 2001

In summary, there are several strategies, characteristics, and approaches supported by scholarship as contributing to teacher professional development that is deemed effective. On the surface, the research sites exhibit some of these characteristics. For example, NSDC's context standards are apparent because school and central level administrators provide time for teachers to participate in teacher professional development sessions as well as coordinate efforts with external sources for resource support to pay for substitutes while teachers are attending sessions. This raises important questions: What other standards for effective teacher professional development are evident in the proposed research and to what extent are teachers infusing these strategies and practices in their classrooms?

<center>Evaluation of Teacher Professional Development Practices</center>

Much of what we know about teacher professional development practices – in all its richness – come as a result of using more and more sophisticated approaches to study the complex activities that comprise teacher professional development. History suggests that the use of more advanced approaches to study teacher professional development was not always the case. For example, research methodologies which were used for many years with regard to teacher professional development included the traditional end-of-workshop "smiley" sheet to measure participants' satisfaction with the teacher professional development program, presenter, and facilities (Killion, 2006, p. 1), what Sparks (1995) termed the "happiness quotient" (Sparks cited in Hawley & Valli, p. 134). Change began in the mid-1990's when very few teacher professional development programs yielded data indicating improving student learning or teacher learning (Killion, 2006, p. 1; Shaha, Lewis, O'Donnell, & Brown, 2004, p. 1). In response, sweeping changes in federal legislation required school districts which received federal dollars for the purpose of teacher professional development to provide evaluations of their teacher

professional development programs (Killion, 2006, p. 1). Many of the research designs which followed this mandate were primarily evaluative in nature and utilized experimental methods of assigning teachers to treatment and control groups to ascertain significance in student achievement. In many instances, pre- and post-test student achievement data were used as a data-collection strategy. For example, "evaluators often use one of the various experimental designs described by Campbell and Stanley (1963) to determine the effectiveness of professional learning programs…many of these designed involved some form of traditional pretesting and posttesing" (Campbell and Stanley cited in Lamb and Tschillard, 2005, p. 1).

In an effort to address the need for more rigorous methods to investigate the impact of teacher professional development on teacher learning and student learning, NSDC began a two year initiative beginning in 1999 to find methods to measure the influence and impact of teacher professional development on teacher learning and student learning (Killion, 2006, p. 1). NSDC discovered that "the major problem with evaluating professional development lay not in the evaluation but the design of professional development" (Killion, 2006, p. 1). If the design of the teacher professional development was strong and lasted long enough to yield significant changes, it would be possible to measure the impact of teacher professional development on student learning (Killion, 2006, p. 1). With this new finding, NSDC devised an eight-step process for measuring the impact of teacher professional development programs. This process began with the concept of assessing the "evaluability" of the teacher professional development program (Killion, 2006, p. 1). Killion (2006) suggested this procedure to assess evaluability of a teacher professional development program:

 Evaluators examine the design of the program to determine its likelihood of producing the intended results; scrutinize the program's goals, objectives, standards of success,

indicators of success, theory of change, and logic model; and ask about the program's

clarity, feasibility, strength, and worth. If, after that analysis, the program is deemed

evaluable, the evaluator moves ahead to Step 2. If the program is deemed *not evaluable*,

the evaluator encourages the program's designer to revise the program. (pp. 1- 2)

The remaining steps in the NSDC's eight-step evaluative process are to: "formulate evaluation

questions, construct the evaluation framework, collect data, collect and organize data, interpret

data, report findings, and evaluate the evaluation" (Killion, 2006, p. 2). NSDC's linear model to

evaluate teacher professional development also stressed the importance of the researcher

believing in the potential for success of the teacher professional development program being

studied. This concept is further explained in the excerpt below:

In addition to using this eight-step process, it is essential that evaluators believe that the

professional development program has the potential to produce the intended results…lack

of belief in professional development's potential-not evaluation-has been the greatest

challenge in evaluating professional development. (Killion, 2006, p. 2)

Thus, the reflections of the researcher were emphasized as an important component in the

evaluation of teacher professional development.

During the quest to use more advanced methods to study teacher professional development to

provide evidence of its impact on teacher learning and student learning, there are still other

viewpoints among scholarship as how to best accomplish this task. For example, it was argued

that "traditional designs (i.e. pre- and post-testing) may create a source of invalidity" (Lamb and

Tschillard, 2005, p. 1), which occurs as a result of a "response shift effect" (Lamb and

Tschillard, 2005, p. 1). That is, the response shift effect "occurs when participants are unable to

give reasonabl[y] accurate estimates of their knowledge and skill levels on a pretest (because of

confusion, misinformation, etc.)…a response shift showing increased learning from the pretest to the posttest may be due to faulty pretest data rather than a successful workshop" (Lamb and Tschillard, 2006, p. 1).

To reduce the response shift effect, Lamb and Tschillard suggested the use of a "retrospective pretest (RPT) in a professional learning situation" (Lamb & Tschillard, 2005, p. 1). Lamb and Tschillard (2005) described the administration of a RPT:

> The RPT is administered at the same time as the posttest, that is, after the workshop. Respondents are asked to answer questions about their understanding or skills AFTER the workshop (that is, now) and then to reflect and answer what they believe their understanding or skill was BEFORE the workshop. (p. 2)

Thus, the RPT "allows researchers to reduce response shift bias because the participants are able to give answers which are based on a more accurate frame of reference" (Lamb & Tschillard, 2005, p. 2).

Unlike Lamb and Tschillard, Champion supported the use of pretest and posttest assessments to measure what participants knew and could actually practice (Champion, 2003, p. 75). Also, Champion maintained that "the real measure of a professional development program's effectiveness lies in what participants learn" (Champion, 2003, p. 75). To measure what participants learn during professional development sessions, Champion (2003) suggested:

> Pausing periodically throughout the event to check participant understanding of the important constructs or models in the program content, asking participants to apply what they learned by completing an action plan or action research project, and encouraging teachers to keep an implementation log to help them reflect on what they are learning. (p. 75)

Champion emphasized that once the evaluation of participant learning was complete, the next step was to ascertain to what extent the participants are using what they have learned (Champion, 2003, p. 76). Thus, understanding and evaluating teacher professional development requires the use of research methods which have the capacity to understand in-the-moment impacts on participant learning during professional development sessions, as well as the impact of teacher professional development on teacher practice.

Scholarship agrees that "evaluating the efficacy of professional development offerings and validating their impact, requires a multi-dimensional approach" (Belzer; Guskey; Killion; Lewis & Shaha; Shaha; Smith cited in Shaha, Lewis, O'Donnell, and Brown, 2004, p. 2). For example, Shaha, Lewis, O'Donnell, and Brown (2004) presented a two-dimensional method to evaluate the impact of teacher professional development programs. In developing this model to evaluate teacher professional development, these researchers highlighted "three types of impacts professional development offerings should be designed to achieve, and therefore upon which they should be evaluated" (Shaha, Lewis, O'Donnell, & Brown, 2004, p. 3): learning impacts, attitudinal impacts, and resource and fiscal impacts. Figure 1 displays this two-dimensional model for evaluation of teacher professional development.

Table 3. Two Dimensions of Program Evaluation: Impacts and Levels of Impact

Levels of Impact	Impacts		
	Learning Impacts	Attitudinal Impacts	Resource Impacts
Teacher Impacts			
Student Impacts			

(Shaha, Lewis, O'Donnell & Brown, 2004, p. 2)

Thus, understanding the impact of teacher professional development on teachers' and students' learning, attitudes, and resources proves critical in the evaluation of teacher professional development.

Guskey (1997) offered yet another approach to the evaluation of teacher professional development. His approach was based on the premise that general surveys and comprehensive literature reviews have not provided information and answers with respect to what characterizes effective teacher professional development (p. 4). Guskey recommended a linear model that incorporated the use of 'quantitative and qualitative analysis of multiple cases' in an effort to obtain a more in-depth understanding of teacher professional development (Guskey, 1997, p. 4). The linear model, "hierarchically arranged from simple to complex," is comprised of five levels of obtaining information about teacher professional development (Lowden, 2005, p. 2). The five hierarchal levels in Guskey's model include: "participants' reactions, participants' learning, organization support and change, participants' use of new knowledge and skills, and student learning outcomes" (Guskey, 2000, p. 82). Each level of this model includes an explanation of the specific questions that should be addressed, how the information should be gathered, what is measured or assessed, and how the information will be used. Each level depends on and builds upon the preceding level. Thus, "…success at one level is necessary for success at the levels that follow" (Guskey, 2000, p. 78).

In an effort to better understand the influence and impacts of teacher professional development on teachers and students, Christine Lowden (2005) framed the following six questions, three of which incorporated Guskey's five levels of evaluation, to evaluate teacher professional development in a school district:

1. What is the nature of the professional development process?

2. What is the nature of the professional development format?

3. What is the nature of the professional development content?

4. What relationship exists between the change in teachers' attitudes and beliefs about teaching and learning and their perceptions of professional development at each of Guskey's five levels of evaluation?

5. How do teachers who have experienced effective research-based professional development process, content, and format evaluate their experiences of professional development at each of Guskey's five levels of evaluation and the teacher change process?

6. How do teachers who have experienced ineffective research-based effective professional development process, content, and format evaluate their experiences of professional development at each of Guskey's five levels of evaluation and the teacher change process? (p. 2)

Lowden concluded that school districts must investigate their current "process, format, and content" of teacher professional development from the perspective of highly effective teacher professional development that is supported by research (Lowden, 2005, p. 13). Further, Lowden emphasized that the "evaluation of professional development should be built into the plan from the beginning…it should not be an afterthought [and] consider making it part of school district policy" (Champion cited in Lowden, 2005, p. 13).

Lowden agrees with Guskey that there is a need for evaluations to "look at how to better influence the professional development on teachers and document its impact on student learning" (Lowden, 2005, p. 1). Killion (2002) found that "evaluation of staff development is most powerful when it": describes the following characteristics of an effective evaluation of teacher professional development.

1. Focuses on results as well as on means.

2. Focuses on the whole as well as the parts.

3. It is highly related to comprehensive planning of programs.

4. Promotes 'evaluation think' (a frame of reference, mindset as well as a set of critical analysis skills). (p. 2)

Also, the North Central Regional Educational Laboratory (NCREL) emphasized that a plan to evaluate teacher professional development "should focus on the use of ethnographic research [and] it also should extend over time in order to describe and give value to the interrelationship of individual change and systemic change in education" (NCREL, 1997, p. 1). Ethnographic research provides an in-depth, holistic view of complex social settings, allowing developing explanatory accounts about why things turned out the way they did (Spradley, 1980). Other examples of ethnographic research used to study teacher professional development include George (2001), who used a qualitative ethnographic research approach to study the use of teacher/staff book clubs as a teacher professional development program in literacy and Ladson-Billings'(1994) ethnographic study of teachers who used culturally relevant teaching practices to meet the needs of African American children.

The North Central Regional Educational Laboratory also suggested that "the evaluation of a professional development program has two important goals: to improve the quality of the program (formative evaluation), and to determine its overall effectiveness (summative evaluation)" (NCREL, 1997, p. 1). NCREL emphasized that a summative evaluation has the following three levels and purposes: "to assess the changes in the educators as a result of participating in the professional development plan, to assess the ways in which the school organization has changed, and to determine the effect of the professional development on student learning" (NCREL, 1997, p. 2). Thus, evaluating teacher professional development also requires

an understanding and description of the changes that may occur in teacher practice, student learning, and comprehensive change at the school and/or district level.

In summary, most of the empirical research on teacher professional development has been evaluative in nature and incorporated experimental research designs with the primary focus on student achievement and changes in teacher practice. Many of the methods used classroom observation data, students' performance data on standardized tests, teacher surveys, teacher interviews, student surveys, and student interviews. While these designs and methods have highlighted some of the important issues worth studying with regard to teacher professional development such as changes in teacher practice and changes in student achievement; they have fallen short in studying teacher professional development from the perspective of the school context or culture of professional learning in which it occurs. In fact, a recent NSDC report on the status of professional learning indicated that there is a "need to study which approaches are most effective for different purposes in a range of contexts and for teachers at different points in their career" (Darling-Hammond & Richardson, 2009, p. 6). In what follows, this concept is further explored by providing a more detailed look at a school context or culture of professional learning from the perspective of professional learning communities.

Professional Learning Communities

As revealed in the previous section, understanding the impact of teacher professional development requires the use of more and more sophisticated approaches. Using more advanced and multi-dimensional approaches will not only help to understand the impact of teacher professional development on teacher learning, teacher practice, and student learning, but it will also help to clarify the complexities surrounding the culture and context in which these phenomena occur. Before a discussion commences regarding research methods that have the

capacity to accomplish this task, a school context of professional learning will be understood through a discussion of a professional learning community.

During the early 1990's, the concept of a professional learning community originated from the business world regarding the ability of organizations to learn (Vescio, Ross, & Adams, Alyson, 2008 p. 81). Critical to the conceptualization of a professional learning community was Senge's, <u>The Fifth Discipline: The Art and Practice of a Learning Organization,</u> which described "learning organizations" that would increase productivity and innovation. Senge (1990) described a learning organization to be:

> where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together. (Senge cited in Hord, 1997, p. 18)

Soon after the idea of a learning organization was adopted by the business community, educators began to embrace this concept and the term "learning organization" was soon changed to "learning communities" in order to better align with an education community. (Hord, 1997, p. 18). Astudto and colleagues (1993) defined a professional learning community as a:

> professional community of learners, in which the teachers in a school and its administrators continuously seek and share learning, and act on their learning. The goal of their actions is to enhance their effectiveness as professionals for the students' benefit. (Astudo and colleagues cited in Hord, 1997, p. 6)

Benefiting students' is further supported by NSDC's emphasis that "members of learning communities take *collective* responsibility for the learning of all students represented by team members." (NSDC, 2009, para. 3) Thus, the primary focus of a professional learning community

coheres to that previously emphasized as the primary goal of teacher professional development: student learning and achievement through the enhancement of teacher practice.

<div align="center">Professional Learning Community Concepts</div>

As discussed below, there are specific attributes or concepts central to professional learning communities. These include a shared vision, development and nurturance of professional relationships, collaboration among members, job-embeddedness, and cyclical processes and activities.

A shared vision among the members of a professional learning community is more than just a unanimous agreement to a particular idea or concept (Public Schools of North Carolina, 2009, p. 6). It is a "particular mental image of what is important to an individual and to an organization" (Public Schools of North Carolina, 2009, p. 6). Further, a shared vision should be collectively developed by the members of a professional learning community as well as used as a guide to make decisions about teacher practice and student learning (Hord, 1997, p. 19). It is not the existence of a professional learning community alone that influences outcomes, but what the professional learning community chooses to focus on.

The development and nurturance of *caring* professional relationships, the second attribute of a professional learning community, is an important concept of professional learning communities (Hord, 1997, p. 20). The caring nature of the professional relationships among members of a professional learning community becomes evident by communication that is open (Public Schools of North Carolina, 2009, p. 20). Further, caring and engaging in open communication are made possible in a professional learning community because of the trust that members have for one another. (Hord, 1997, p. 20). For example, in a professional learning community,

Teachers find help, support, and trust as a result of the development of warm relationships with each other. Teachers tolerate (even encourage) debate, discussion, and disagreement. They are comfortable sharing both their successes and failures. (Wignall cited in Hord, 1997, p. 23)

Thus, professional learning communities provide a venue for teachers to freely share their professional experiences and practices with their colleagues.

With a shared vision and the nurturance of caring professional relationships, professional learning communities can begin their work of collaboration, the third major concept central to professional learning communities. For example, "educators who are building a professional learning community recognize that they must work together to achieve their collective purpose of learning" (Dufour, 2004, p. 5). In fact, collaboration should be a continuous process of teachers working together to understand and improve their practice for the purpose of improved student learning and achievement (Dufour, 2004, p. 5).

Just as collaboration among teachers in a professional learning community should be continuous, the work of professional learning communities consists of cycles of continuous improvement or cyclical processes and activities, the fourth major concept of professional learning communities. For example, "teachers, staff, principal, students, and parents develop habits of continual learning—study, plan, act, reflect, and refine learning as a cycle" (Speck cited in Zepeda, 2004, p. 144). The idea of a process model of teacher professional development, mentioned earlier implies that "teachers must participate in cycles of activity" (Huberman cited in Sykes, 1999, p. 174), as well as "continuous and ongoing" (Hawley & Valli, 1999, p. 138), both aspects that NSDC supports. In fact, it has been concluded that the ultimate goal is not just to "be a professional learning community," but participants should pursue goals that incorporate

"continuous inquiry, continuous improvement, and the achievement of school improvement goals" (Public Schools of North Carolina, 2009, p. 15).

The continuous improvement cycles of professional learning communities should ideally be built into the regular, daily practices of the school (Burnett, 2002, p. 52). This idea represents the last central concept of professional learning communities, job embeddedness. The professional learning community should be the primary vehicle for teacher professional development with "time for collaboration [that is] embedded in teachers' daily and weekly schedule" (Dufour, R. & Dufour, B., 2007, p. 27). Thus, just as the provision of time and job embeddedness were discussed in an earlier section as important characteristics for effective teacher professional development, they are also critical in the development and sustainment of a professional learning community that occurs as a natural part of the school day:

> Purposeful collaboration, collective inquiry, action research, and seeking evidence of results to inform individual, team, and school practices will be so deeply embedded in educators' routine work that they will consider these powerful learning experiences as simply 'the way we do things around here.' (Dufour, R. & Dufour, B., 2007, p. 27)

Professional Learning Community Practices

What exactly does the work of a professional learning community entail? What specific activities or practices are participants of professional learning communities engaged in during the school day to improve teacher practice and student learning? There are six major practices which participants of professional learning communities engage in to improve student learning: peer observation, dialogue, reflection, collective inquiry, analysis of student data, and the development of common assessments.

Peer observation, or shared personal practice as it is sometimes termed, is "the norm in the professional learning community" (Louis & Kruse cited in Hord, 1997, p. 23). Teachers in a professional learning community should regularly visit their colleagues' classrooms (Hord, 1997, p. 23). This practice has been found to add depth to teachers' understanding of their practices (Darling-Hammond cited in Hord, 1997, p. 28). Additionally, it is important to note that the practice of peer observation is not an evaluative process, but rather a process that is based upon the trust and respect that has been developed and nurtured among members of the professional learning community (Hord, 1997, p. 23).

Peer observation can serve as a catalyst for stimulating professional conversations or dialogue, the second major practice of a professional learning community (Schuck, Aubusson, & Buchanan, J., 2008, p. 225). In fact, it is doubtful that peer observation with accompanying feedback alone should be offered as a strategy for improvement; however coupled with dialogue, it can provide a method for teachers to deepen their professional understandings of their practice and student learning (Hammersley-Fletcher & Orsmond cited in Schuck, Aubusson, & Buchanan, 2008, pp. 217-218). Similarly, "critical conversations provide a means to elucidate thinking about pedagogy embedded in teaching and learning episodes" (Loughran cited in Schuck, Aubusson, & Buchanan, 2008, p. 218). Further, it has been argued that members of a professional learning community are provided with opportunities to actually debate their understandings of teacher practice through the practice of dialogue. (Bullough & Pinnegar cited in Schuck, Aubusson, & Buchanan, J., 2008, p. 216) In fact, dialogue in a professional learning community has been described as the "glue to affirm its values and its membership" (Sterling cited in Zepeda, 2004, p. 144).

The practice of dialogue, the third major practice associated with a professional learning community, can extend into the activity of teachers reflecting on their practices. For example, Bullough and Pinnegar (2001) emphasized that "teachers and other professionals negotiate their understandings of practice through reflection and learning conversations (Bullough & Pinnegar cited in Schuck, Aubusson, & Buchanan, 2008, p. 216). In another study, teachers reported that they were more apt to reflect on their practices as well as "inquire more deeply" about their practices and student learning as a result of dialogue (Zepeda, 2004, p. 149). Further, Louis and Kruse (1995) used the term "reflective dialogue" to describe the discussions of staff about their practices and student learning while identifying challenges associated with them (Louis & Kruse cited in Hord, 1997, p. 18). These types of discussions and activities were referred to as inquiry (Griffin cited in Hord, 1997, p. 18). Inquiry is the next practice of a professional learning community which is discussed below.

One participant of a professional learning community described inquiry as a collaborative, learning, and "researched-based process of addressing hard questions about student learning and achievement" (Livesay, Moore, Stankay, Waters, Waff, & Gentile, 2005, p. 17). Inquiry is thought to be responsible for improving and strengthening the conditions for improved teacher practice and student learning, because teachers are in a continual process or cycle of understanding and responding to what is occurring in their classrooms and schools (Achinstein, Little, Mclaughlin & Talbert cited in Livesay, Moore, Stankay, Waters, Waff, & Gentile, 2005, p. 16). It has also been suggested that when experienced teachers have opportunities to collectively engage in inquiry, a knowledge base about teaching and learning is produced that can be shared with a wider audience (McLaughlin & Talbert cited in Hord, 1997, p. 10). Still another important feature of engaging in inquiry is that as members of a professional

learning community seek deeper understandings as a collective body, they are actually helping to create, build, and sustain a community of learners (Griffin cited in Hord, 1997, pp. 18-19). Thus, through inquiry, members of a professional learning community encourage a deeper understanding of teacher practice and student learning by appreciating the work and views of others in the professional learning community (Griffin cited in Hord, 1997, p. 18).

Professional learning communities understand and communicate how their activities or practices impact teacher practice and student learning by collecting and analyzing student data, the fifth professional learning community practice (Vescio, Ross, & Adams, 2008, p. 82). Additionally, the collection and analysis of student data is an ongoing practice of a professional learning community (Burnett, 2002, p. 52). The actual learning of members in a professional learning community "begins by examining data about student learning and the desired level of student learning" (Richardson, 2008, p. 69). Thus, through the professional learning community practice of analyzing student data, we again see the importance and prerequisite of aligning teacher learning with student learning, an idea that was previously discussed.

Professional learning communities use the collection and analysis of student data to develop common assessments for their students, the last professional learning community practice. Some posit that the production of such documents actually helps to keep professional learning communities focused on student learning (Burnett, 2002; Dufour, 2004). After the common assessment is administered to students and data are collected from the results, professional learning communities engage in continued analysis, dialogue, and reflection in an effort to investigate areas of strength and improvement among students and collaborate on how to best address these strengths and weaknesses (Dufour, 2004, p. 6). Thus, we again see the professional learning community concept of cyclical processes and activities emerge as members

participate in cycles of collaborative activities to enhance teacher practice and achieve improved student learning.

In summary, the concepts and practices associated with professional learning communities discussed in this section are supported by scholarship and embraced by professional educational associations as being a viable and powerful form of teacher professional development. Professional learning community practices are a powerful form of teacher professional development because they not only incorporate many of the previously discussed characteristics and concepts that have been recognized by scholarship as essential for effective teacher professional development, but also because these characteristics and concepts combine to form a purposeful, structured, and continuous culture of collaboration among a group of individuals who have a shared commitment to improve student learning and achievement through the enhancement of teacher practice. Further, "researchers who have studied schools where educators actually engage in professional learning community practices have consistently cited those practices as our best hope for sustained, substantive school improvement" (Dufour, 2007, p. 3). Thus, it is reasonable to study these particular research sites because it is apparent that teachers who participate in the program have continuously met with one another during the course of an academic year and have participated in ongoing teacher professional development with internal and external sources. The questions then arise: What other professional learning community activities or practices are these teachers engaged in during the course of the teacher professional development and to what extent are these practices infused in the teachers' classrooms? In Chapter 3, I will advance a framework to study such questions as well as understand how the teacher professional development program in the research proceeds, what teachers learned about the instruction of mathematics in the teacher professional development

program, and to what extent teachers infused teacher professional development practices in their

classrooms.

CHAPTER 3

METHODOLOGY

Not only are professional learning community practices effective forms of teacher professional development, but documenting their impact on teacher practice and student learning seems just as important. In fact, "research should draw broadly across various methodologies to document the creation of professional learning communities and their impact" (Vescio, Ross, & Adams, 2008, p. 90). Also, there should be a "rigorous reporting" of such research methodologies to justify the resources that are necessary for the sustainment of professional learning communities (Vescio, Ross, & Adams, 2008, p. 90). Further, "one immediate need is research that would seek more descriptive examples of how professional learning communities function and how contextual variables influence what they look like and what they do" (Hord, 1997, p. 56). This call for research which takes into account the various contexts in which teacher professional development occurs remains left unanswered according to the recent NSDC status report on professional learning that stressed the "need to study which approaches are most effective for different purposes in a range of contexts and for teachers at different points in their career" (Darling-Hammond & Richardson, 2009, p. 6). As will be detailed later in this chapter, this research studied teacher professional development from the perspective of the context in which it occurs and the teachers who are participants.

Utilizing research methodologies such as those outlined above is challenging as they seek to capture the essence of this [teacher professional development] contextually driven process. In what follows, I offer a methodological framework which can be used to understand professional learning community concepts and practices from the perspective of the context or culture in which it occurs.

As discussed in Chapter 2, teacher professional development should achieve the content, context, and process standards as established by NSDC that reflect the characteristics and strategies for effective teacher professional development while at the same time providing teachers with opportunities to participate in learning that are "cycles of activity" or continuous, and actually embedded as a natural part of their work. While many of the methods used to evaluate teacher professional development have been linear in design (i.e. NSDC's eight-step process, Guskey's hierarchal five levels of evaluation), the cyclical nature that effective teacher professional development requires calls for the deployment of a research method that is also cyclical in its design and approach to be able to capture and understand these "cycles of activity" in teacher learning.

Chapter 2 also emphasized that successful teacher professional development accomplishes: theoretical understandings and subject area knowledge as components of teacher learning, changes in teacher practice, a job-embedded nature of teacher learning, improvements or enhancements to student learning, an alignment of teacher learning to student learning, and systemic change in a school district. Ultimately, teacher professional development should achieve a culture of learning through the emergence of a professional learning community in which the professional development standards and effective characteristics of teacher professional development are realized "through all participants—parents, learners, teachers, community members, intellectuals, and political leaders—in a continual process of evolving education" (Fulton & Riel, 2005, p. 2). Teacher professional development as described requires a research method that pays close attention to the culture in which it occurs and is, in and of itself, a "continual process." Spradley's (1980) ethnographic research cycle is one such method that meets these requirements. Spradley's ethnographic research cycle is a cyclical research process

which incorporates the collection of multiple forms of data such as observations, interviews, the collection of cultural artifacts, focused groups, and uses a researcher's journal. These data are in a continual process of analysis such that each form of analysis informs the next type of data collection and subsequent analysis. Figure 1 is a graphic display of Spradley's ethnographic research cycle.

Figure 1. Spradley's Ethnographic Research Cycle (Spradley, 1980, p. 29)
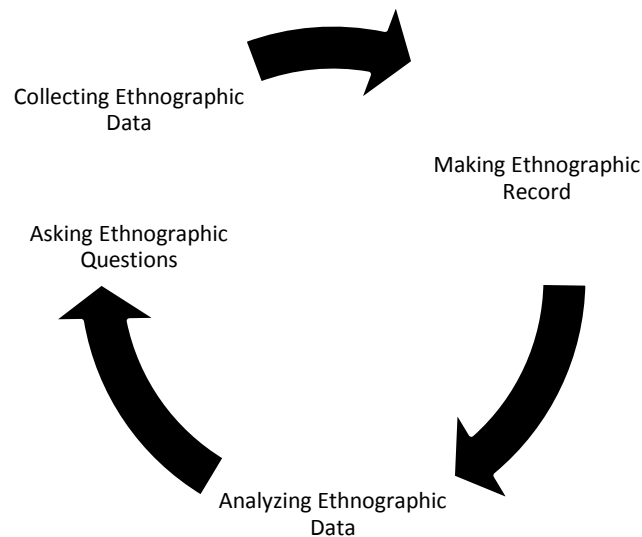
Spradley's ethnographic research cycle was employed in this research while incorporating Lamb and Tschillard's (2005) Retrospective Pretest Model for evaluating teacher professional development in which "respondents are asked to answer questions about their understanding or skills AFTER the workshop (that is now) and then to reflect and answer what they believe their understanding or skill was BEFORE the workshop" (p. 2). Thus, the integration of Lamb and Tschillard's Retrospective Pretest Model for evaluating teacher professional development with Spradley's ethnographic research cycle was used in this study to provide explanations to:

1. How does the teacher professional development program proceed?

2. What did teachers learn about the instruction of mathematics in the teacher professional program?

3. To what extent did teachers infuse teacher professional development practices in their classrooms?

4. To what extent do the teacher professional development program and teachers' practices in their own classrooms and schools enact or further engage professional learning community practices?

<div align="center">Research Purpose, Scholarly Paradigm, and Definitions</div>

The purpose of this research is to explore, understand, and describe the professional development experiences of four high school teachers who teach mathematics in urban and suburban schools. The utilization of Lamb and Tschillard's Retrospective Pretest Model for evaluating teacher professional development integrated with Spradley's ethnographic research cycle was utilized from a naturalistic perspective or paradigm. The naturalistic paradigm views the world the way it is, without undue made changes for research purposes. That is, it seeks to describe naturally occurring phenomena that is already occurring independent of the research - not reproduced or manufactured for the purpose of research (Genzuk, 2003, p. 3). Some of the axioms which comprise the naturalistic perspective or paradigm are: 1) realities are multiple, holistic and constructed, 2) inquiry is value bound, and 3) entities are in continuous mutual shaping so that causes and effects are impossible to determine--not causative (Lincoln & Guba, 1985, p. 37). A naturalistic perspective is appropriate for this research because this teacher professional development is a phenomena that was already occurring before the decision was made to engage in this study. Additionally, this paradigm acknowledges the cyclical nature of

successful teacher professional development, especially "entities are in a continuous mutual shaping" (Lincoln & Guba, 1985, p. 37). Scholarly definitions of culture and ethnography guided this research study. Culture is defined to be the "beliefs, attitudes, norms, social arrangements, and forms of expression that form a describable pattern in the lives of members of a community or institution" (LeCompte & Schensul, 1999, p. 21). Ethnography is described as being the "work of describing a culture," "understanding the way of life from the native point of view" and "learning from people" (Spradley, 1980. p. 3).

Recruitment and Research Sites

In order to find the four teachers who agreed to participate in this study, 15 schools and/or school districts and one university were contacted. At four of the sites, a brief meeting and presentation were provided to potential research participants to describe the study. The teachers either chose not to participate, were not involved in the type of teacher professional development being studied, or the school district was not accepting research proposals at that time. Additionally, phone calls and emails were made to schools and potential participants to introduce the study.

Data Collection Strategies

Three types of data comprised the data collection activities of this research. These data are: interviews, artifacts, and a researcher's journal. Interviews in this research were in-depth and open-ended. In-depth, open-ended interviewing is a specific form of interview used in ethnographic research (Schensul, Schensul & LeCompte, 1999, p. 121). The term, in-depth, "means to explore a topic in detail to deepen the interviewer's knowledge of the topic" (Schensul, Schensul & LeCompte, 1999, p. 121) and open-ended "refers to the fact that the

interviewer is open to any and all relevant responses" (Schensul, Schensul & LeCompte, 1999, p. 121).

Four high school mathematics teachers were interviewed three times during the course of the proposed research. Each interview was held from 60 to 90 minutes at a place that was mutually agreed upon between the researcher and the school administration. Interviews were audiotaped and transcribed. There was a link across the data from the three interviews with individual teachers. Data from the individual teacher interviews were coded with numerical identifiers. For example, to link data from a teacher's first, second, and third interview, the same numerical identifier was assigned to the data of this teacher's first, second, and third interview. A paper copy of a list displaying these numerical identifiers was kept in the principal investigator's locked file cabinet at the principal investigator's house and an electronic version was kept on the principal investigator's password-protected personal laptop. The principal investigator had access to this list in order to conduct the analyses of data and the principal investigator's dissertation major advisor had access to this list in order to advise on the analyses of data. To maintain confidentiality, the principal investigator kept the paper list of numerical identifiers in a locked file cabinet at the principal investigator's house and an electronic copy was on a password-protected personal computer, both file cabinet and personal computer were used only by the principal investigator. Audiotapes of interviews were stored in a locked file cabinet at the principal investigator's house. All numerical identifiers and audiotapes will be destroyed immediately following the successful defense of the dissertation. To protect the anonymity of interviewees, pseudonyms were used in transcriptions. An interview protocol was developed that indicates the purpose of the research, the questions of the interview with appropriate probes, and the fact that all audiotapes will be destroyed at the end of the study. Teachers who participated in

the teacher professional development were selected because they were the "key informants" or the most knowledgeable about the topics of the proposed research (Schensul, Schensul & LeCompte, 1999, p. 122). Further, due to the participants' wealth of knowledge relative to the inquiries of this research, it was "not necessary to interview many key informants to obtain a large amount of information about a subject" (Schensul, Schensul & LeCompte, 1999, p. 122).

Each of the three teacher interviews had a distinctive purpose. The purposes of the first interview with teachers were to understand: teachers' beliefs and attitudes with respect to teacher professional development, the organization and culture of the school and district in which the teacher professional development occurs, and the teacher professional development practices or activities which these teachers may engage in. The types of items in the first interview protocol were designed to obtain information from teachers regarding key events of the teacher professional development, narratives of their experiences in the teacher professional development program and to elicit cultural domains to be further analyzed during the course of the proposed research.

The purpose of the second teacher interview was to understand how teachers in the proposed research actually use what they learned in the teacher professional development in their classrooms. This interview was "quasi-observational" in the respect that teachers were asked to explain or describe a lesson that best displayed how they used in classrooms what they learned in the teacher professional development. Rather than disturbing the everyday functions of a classroom, I acted as a student while the teacher used a whiteboard or easel paper to demonstrate or walk through a lesson. This type of data collection strategy is analogous to social mapping. Social mapping is a form of "data gathering" in which "community people are asked to create a map of their own village or neighborhood." (Schensul, Schensul, & LeCompte, 1999, p. 129).

The actual map that is drawn by the key informant becomes data which will be analyzed by the researcher. Asking the teacher to explain or demonstrate a lesson using a whiteboard or easel paper, while I took notes and asked clarifying questions, is analogous to social mapping because the information on the whiteboard or easel paper and my notes became the actual data collected from this quasi-observation.

The types of questions that were used to guide such a quasi-observation can be classified as "task-related grand tour questions" (Spradley, 1979, p. 87). According to Spradley (1979), grand tour questions elicit from the informant "a verbal description of significant features of the cultural scene" (p. 87) and task-related grand tour questions "ask the informant to perform some simple task that aids in the description" (p. 87). In the case of the second interview with the teachers, the "simple task" was for teachers to demonstrate or explain a lesson that or activity that best displays how they use in classrooms what they learned in the teacher professional development. As the teacher explained a lesson to me, I asked clarifying questions such as, "What is this?" and "What are you doing now?" (Spradley, 1979, p. 88). It was emphasized before the second interview commenced that this activity was not evaluative in any way, rather a method to expand and deepen the researcher's knowledge of how the teachers used what they learned from the teacher professional development in their classrooms.

The third interview with teachers incorporated Lamb and Tschillard's (2005) Retrospective Pretest Model in which questions were asked to understand teachers' learning after the teacher professional development while at the same time ascertaining their perception of their knowledge and/or skills before the teacher professional development. Teachers were asked to rank the activities which comprised the Algebra 1 teacher professional development that they perceived had the greatest and least impact on their: beliefs and attitudes related to mathematics

teacher professional development, content knowledge and theoretical understandings, instructional practice, and student learning. According to Schensul, Schensul & LeCompte (1999), ranking questions are questions in which the "respondent is asked to order each item in relation to the others in a finite and given list of no more than 10 items" (p. 186). Additionally, the third interview with teachers investigated teachers' perceptions of the impact their learning from the teacher professional development had on their students' learning.

In summary, the first interview gathered information about how teacher professional proceeded with particular focus on the teacher participants and the professional development activities that they engaged in. The second interview served as a follow-up to the first interview with emphasis on the use of or application of what teacher participants learned from their teacher professional development. Lastly, the third interview was a retroactive pretest of their learning which provided teachers with an opportunity to reflect- at the same time - on their learning before and after the teacher professional development. Also integrated in the second and third interviews were member checks to allow the researcher to verify with interviewers interpretations of data obtained from the previous interview.

As previously described in the second teacher interview protocol, teachers were asked to demonstrate a lesson in which they applied strategies learned from the teacher professional development in their classrooms on either a white board or easel paper. The notes that I took during this quasi-observation are not only data, but are also cultural artifacts because the notes are a result of a quasi-observation of what strategies or tools teachers use to during a lesson. Similarly, Spradley (1980) describes cultural artifacts as "things people make and use like clothes and tools" (p. 10). Additionally, teachers were asked to bring artifacts such as agendas, schedules, and written activities related to the teacher professional development to the second

interview. All identifying information were removed using a permanent black marker and an identification number of the participant was assigned to each item.

Finally, a researcher's journal was maintained during the course of this proposed research. According to Spradley (1980), a journal "will contain a record of experiences, ideas, fears, mistakes, confusions, breakthroughs, and problems that arise during fieldwork" (p. 71). Further, this journal allowed me to remain cognizant of the various decisions that were made during the course of this study as well as provided opportunities for me to reflect on why this research was personally important to me and how my professional background relates to this research. The latter speaks to the reflexivity of the proposed research, an element for the establishment of trustworthiness which is discussed in a later section.

In summary, the overall goal of the teacher interviews, collection of artifacts, and researcher's journal was to provide a rich, clear description of the cultural scene in which the teacher professional development occurs. For example, the purpose of ethnographic interviewing in the proposed research "is to reduce social and cultural reality to produce a coherent description of a social situation" (Schensul, Schensul & LeCompte, 1999, pp. 147-148). Further, as previously emphasized, one immediate need concerning the research on teacher professional development is the provision of specific examples the influence of the context and culture in which it occurs (Hord, 1997, p. 56). Interviewing and the quasi-observation are data collection activities which will contribute to informing or creating a "local theory" about the culture in which the teacher professional development occurs – a theory that aligns with the perceptions of the participants in this teacher professional development. (Schensul, Schensul, & LeCompte, 1999, p. 146). Ultimately, all of the data collection activities as described become components of an "ethnographic research cycle" that begins with "asking questions to collecting data…to

analyzing ethnographic data," (Spradley, 1980, p. 85) a concept that is discussed in the next section. Table 3 summarizes all of the data collection activities conducted during this study and their alignment to the research questions.

Table 4. Data Collection Matrix

Research Questions (RQ)	First Interview	Second Interview	Third Interview	Artifacts	Researcher's Journal
RQ1	X			X	X
RQ2			X		X
RQ3		X		X	X
RQ4	X	X	X	X	X

- RQ1: How does the teacher professional development program proceed?

- RQ2: What did teachers learn about the instruction of mathematics in the teacher professional development program?

- RQ3: To what extent did teachers infuse teacher professional development practices in their classrooms?

- RQ4: To what extent do the teacher professional development program and teachers' practices in their own classrooms and schools enact or further engage professional learning community practices?

<div align="center">Data Analysis Strategies</div>

The data analysis strategies used to integrate Lamb and Tschillard's Retrospective Pretest Model with Spradley's ethnographic research cycle were continuous, allowing the findings and results of one analysis to inform the next level of analysis. Transcription and analysis were

conducted immediately following each of the three interviews with teachers. For example, a semantic domain analysis that looks for patterns of sameness and develops underlying patterns was conducted during the first stage of analysis. Next, these patterns were organized into sets of meanings in a taxonomic analysis. The taxonomic analysis organized the patterns found during the semantic domain analysis which was used later as an outline to begin writing the findings. Finally, the sets of meanings organized during the taxonomic analysis were compared across meaningful contrasts in a componential analysis by comparing study findings as they related to the four teacher participants. All of these analyses were conducted according to Spradley (1980). The methods used for data analysis were triangulated which adds to the overall credibility and trustworthiness of this study, a point that will be further discussed at the end of this chapter.

During the cyclical analysis of data, there was an opportunity to incorporate a narrative analysis in this research study. In a narrative analysis, the listener is taken to a "past time or 'world' and recapitulates what happened to make a point that is sometimes a moral one" (Riessman, 1993, p. 3). A "fully formed" narrative analysis includes six components: abstract (summary or snapshot of situation that is being told), orientation (time and place of participants), conflicting action (sequence of events), evaluation (significance of events, attitude of the narrator), resolution (articulation of what happened), and coda (narrator comes back to the present) (Riessman, 1993, pp. 18-19). The narrative analysis provided an opportunity to understand and describe the actual viewpoints and personal experiences of participants regarding their teacher professional development.

<p style="text-align:center">Trustworthiness Justification</p>

Trustworthiness was achieved by using the criteria established by Lincoln and Guba (1985). Trustworthiness is defined to be "how [the] inquirer [will] persuade his or her audiences

(including self) that the findings of an inquiry [and methods] are worth paying attention to [and] worth taking account of" (Lincoln and Guba, 1985, p. 290). The criteria for trustworthiness include the following components: trustworthiness: credibility, transferability/applicability, dependability, confirmability, and the reflexive journal (Lincoln and Guba, 1985, p. 328).

Credibility, the first criterion for trustworthiness, includes 7 components: prolonged engagement, persistent observation, referential adequacy, triangulation (sources, methods, and investigators), negative case analysis, peer debriefing, and member checks (Lincoln and Guba, 1985, p. 328). Prolonged engagement, or the length of time in the field, was established because the proposed research commenced during the fall of 2009 and concluded in the spring semester (June) of 2010. Persistent observation, or the quantity of observations and analyses, was established through the very cyclical nature of this study because this study was based on the cyclical analyses of the semantic, taxonomic, and componential data analysis strategies. Referential adequacy can be described as continuously asking myself, "Do I have enough data?" during each stage of the data collection. If the answer to this question was "no," than I returned to my modes of data collection and strategies for analyses. Triangulation, or the corroboration of the results from one type of data to the results of a different type of data, was accomplished through the use of multiple methods of data collection (i.e. interviews, quasi-observation, artifacts, research journal) which comprise this study as well as the multi-levels of analysis (semantic, taxonomic, and componential). Additionally, triangulation is apparent through the interviews of the four teacher participants. Peer debriefing, or talking about the process of conducting this study with those who were also engaged in this type of research, was accomplished because the researcher routinely talked to peers in the same doctoral program in order to obtain feedback regarding this research. Negative case analysis, or ensuring that I am

not describing something that cannot be confirmed in my data, was captured by always staying close to the data collected and remaining cognizant of the data collected. Member checks or asking the participants of the teacher professional development whether not data were accurately interpreted from interviews was conducted at every phase of data collection.

Transferability or applicability, the second criterion for trustworthiness, implies that one may be able to transfer or apply the findings of this study to another context (Lincoln and Guba, 1985, p. 316). Transferability was established through thick and rich descriptions in the descriptive and componential findings.

Dependability, the third criterion to establish trustworthiness, refers to the consistency of the study in terms of having an audit trail (paper audit trail) available that clearly shows reader easily the connection between data, analysis, and findings. The organization of this research in and of itself will contribute to the dependability of this research because all of the interview transcripts and domain analyses, for example, were maintained in research notebooks during the course of this study. When I prepared to write, I returned to these notebooks which contained data from all of the collection modes and review all analyses. The findings and conclusions were supported by the data through analyses and presented in the report by conducting an audit check. The data collection matrix presented earlier in this section also assisted in this audit check.

The fourth criterion, confirmability, is in alignment with the establishment of dependability for this study in that "the major technique for establishing confirmability is…the confirmability audit" (Lincoln and Guba, 1985, p. 318). Thus, as with dependability, confirmability was established by maintaining a research notebook that included, for example, all raw data such as cassettes, condensed and expanded accounts of fieldnotes, notes from domain

analyses, and listings of all interviews and artifacts in order to ensure that an audit trail from the data to the analysis to the text were purposefully transparent and evident.

Finally, the last technique to establish trustworthiness in the proposed research is to maintain a reflexive or researcher's journal. A reflexive journal is "a kind of diary in which the investigator on a daily basis, or as needed, records a variety of information about self and method" (Lincoln and Guba, 1985, p. 327). In terms of information about self, the journal provided daily opportunities to reflect upon the research in terms of my background and relationship to the study. With respect to information about methods, keeping a journal allowed me to constantly record the "methodological decisions made and the reasons for making them" (Lincoln and Guba, 1985, p. 327). This information also contributed to the study's audit trail. (Lincoln and Guba, 1985, p. 327).

CHAPTER 4

EXPERIENCES WITH TEACHER PROFESSIONAL DEVELOPMENT

The teacher participants experienced professional development under a variety of contexts and circumstances. These contexts are important to realize and highlight because they shape the specific actions that the teachers will eventually engage in as they incorporate strategies and concepts from their professional development into their daily instructional practices. This chapter begins by describing the contexts in which each of the teachers taught mathematics at their respective schools and provides insights into their individual perspectives and understandings of teacher professional development. The chapter proceeds with descriptions of the participants' experiences with professional development, followed by a discussion of the specific types of professional development activities that the teachers were engaged in and how these activities impacted various aspects their perspectives about teacher professional development, content knowledge, instructional practice, and students' learning. Collaboration is revealed as an important teacher professional development activity that was engaged in by the teacher participants. The chapter concludes with a discussion of the teacher participants' reactions to their teacher professional development experiences.

Teacher Participants and Contexts for Teaching

Alice, Bill, Carter, and Diane (pseudonyms) are men and women, who teach in public and parochial schools who have different levels of experience. They teach in three high schools, representing three school districts in Michigan. Two of the high schools are in public school districts, while the third is in a parochial school district. Participants had from one year to 38 years of teaching experience. Alice has taught geometry and algebra courses for a year and a half in a public high school. Bill has been teaching mathematics at his public high school for 24

years, including 12 years of teaching algebra. Prior to this experience, he taught mathematics at a parochial school for 14 years, totaling 38 years of teaching experience. During his first years of teaching, Bill also taught science. Carter began his teaching career at a parochial high school where he has taught algebra for fifteen years. Diane taught algebra courses at a parochial high school for eight years.

The school districts in this study contrast sharply in terms of the ethnicity of their students, income levels of surrounding neighborhood and test scores. For example, two of the school districts are in urban areas with predominately African American students (98%); while the other school district is in a suburban area with predominately Caucasian students.

Teachers' descriptions of challenges they encounter during their instruction of mathematics included concerns about students, and about their mathematics programs. Starting with concerns about students, Alice mentioned discipline and attendance issues, noting further, "…these kids have so many issues that we don't even know about" (Alice, Interview 1, p. 3). Additionally, Alice and Bill described their students' reading challenges, saying "…our kids don't read..."(Alice, Interview 2, p. 3) and "…it's almost like they can't read…"(Bill, Interview, 3, p. 7). Further, Alice and Diane indicated that their students do not consistently complete homework, saying "…they're just not taking it home and doing it" (Alice, Interview 1, p. 3) and "…you always get a few students that…make choices not to do homework or just don't want to be there" (Diane, Interview 1, p. 4).

Also, teachers experienced concerns about their mathematics programs. Carter and Alice described the amount of material and standards which must be covered in their schools and districts, saying: "Each chapter is very extensive and there's just no time and with our type of students; it's almost impossible" (Alice, Interview 1, p. 2) and "You know we have all this stuff

and all these standards to get through and there's only 180 days and so you rush through everything" (Carter, Interview 2, p. 2). Also, Diane described her students as being "calculator dependent" (Diane, Interview 1, p. 2) and as "hav[ing] lost [a] basic understanding of numbers" (Diane, Interview 1, p. 3). Thus, teachers found their students' readiness for mathematics learning ill-matched to the mathematics programs being taught.

Even though these challenges in instructing their students left the teachers frustrated at times (Alice, Interview 1, p. 3 and Diane, Interview 1, p. 4, Carter, Interview 1, p. 3 and p. 4), the teachers and the high schools in this study attempt to address their students' struggles in learning mathematics in numerous ways. For example, one high school designed an algebra course that progresses at a slower pace than other algebra courses at that school. On the other end of the spectrum, Alice's high school developed pacing guides for their algebra courses to ensure topics were *completely* covered. Also, in response to students not consistently completing homework assignments, Alice decreased the amount of work that she gives students to take home and "consolidate[ed] [their work] onto…one page," information presented in the book that she uses during class lessons (Alice, Interview 1, p. 2). Finally, Alice's and Bill's high schools implemented an algebra course that primarily utilizes a computer software program that is student-paced during class lessons.

The teachers' exemplified a commitment to helping their students achieve success in mathematics. First, they stayed in their classrooms and taught. For example, when describing her professional development during summer institutes, Alice revealed, "…I did take it [professional development] during the summer and I prefer that because I don't like to be out of my classroom" (Alice, Interview 1, p. 4). Additionally, Alice commented, "…being only a teacher for a year and a half [I'm still] picking up things that help me to teach something. Just because

you know how to do it, you know the concept, doesn't mean you can teach it" (Alice, Interview 1, p. 4). Carter indicated that, after teaching the elementary algebra class that moves to a slower pace than the regular algebra classes at his school, he "…actually loved the fact that [they've] set up this elementary algebra" (Carter, Interview, 1, p. 1] and that he "…learned to kinda love those kids" (Carter, Interview 1, p. 4). Also, Diane's comments below illustrate her commitment to dispelling students' perceptions of themselves that they will not be successful in learning mathematics. (Diane, Interview, 1, p. 3 - 4)

> I think with math especially, by the time they [students] get to high school, they've either been tracked as a good math student or a bad math student. And to kind of break the mold of…you're not necessarily a bad math student, it just takes you a little more work, but you can understand it.
>
> It's been a challenge to just get them to want to try. And it's the number of times that I've heard students say, 'Well my mom's bad at math so I'm bad at math.' No, not necessarily… so just breaking some of those molds.
>
> It's amazing how many of the students have even just told me [that] 'My teacher told me I'm bad at math, so it's gonna be a bad year.' No, no, it's not. It might take you more work…but you can do this.

Thus, teachers had a strong commitment to help their students learn mathematics. This commitment was also exemplified through their understanding of the critical role that teacher professional development plays as a way to improve their instructional practice. As will be detailed in the subsequent sections, all of the teacher participants were engaged in different forms of teacher professional development and have used strategies and concepts that they learned through their teacher professional development experiences to assist them during their

mathematics instruction. The next section begins the discussion of teacher professional development among the teachers in this study by describing their understandings, views, and perspectives on teacher professional development.

Teacher Understandings and Perspectives on Teacher Professional Development

Teacher participants emphasized that effective teacher professional development depends on individual teachers' perspectives and opinions about teacher professional development. Carter exemplified this when he stated,"…some of it's [teacher professional development] bad, but I think a lot of it is on the onus of the teacher…I think teacher professional development only works if the teacher wants to be developed" (Carter, Interview 1, p. 5). Also, Alice indicated that the more teacher professional development in mathematics she receives, the more she wants (Alice, Interview 3, p. 4). Similarly, Diane explained the responsibilities of the teacher with respect to teacher professional development when she commented that teacher professional development provides an opportunity to "re-evaluate or question hopefully what you are doing in your classroom…" (Diane, Interview 1, p. 15). Further, Bill explained that "…you don't get to to learn it just by one day. You gotta' go back and do it" (Bill, Interview 3, p. 6). Thus, teachers understood teacher professional development effectiveness in terms of a teacher's commitment to development, especially to returning to the classroom to try out and practice new skills. Here, they see teacher professional development as necessarily connected to ongoing teaching practice, not separated from teaching itself.

And, the tight link between teacher professional development and classrooms influenced these teachers' strong opinions about how good teacher professional development should be designed. For example, these teachers thought that the content of teacher professional development should specifically align to what is currently being taught in the mathematics

classroom. As Bill indicated, "The closer you can pull what you learn to the classroom; the better it is. The better the bridge between the pd [professional development] and your classroom, the better it is" (Bill, Interview 1, p. 3). Further, "…it bothers me when you do training on something and then you have no chance to use it" (Bill, Interview 3, p. 6). Additionally, Carter believed a teacher's willingness to receive teacher professional development must be combined with the design of teacher professional development; such teacher professional development is specific, immediately applicable in a classroom, and "packaged in such a way that I can put in my class," which makes for the "best professional development" (Carter, Interview 3, p. 5).

These teachers indicated that they would like additional professional development on specific instructional strategies that can be applied in their mathematics classroom. For example, Carter mentioned that he would like to collaborate more with colleagues at his school about various reading strategies which can be used in the mathematics classroom (Carter, Interview 3, p. 10). Alice indicated that "…being only a second year teacher, [she] need[s] more knowledge about …different [instructional] strategies" (Alice, Interview 3, p. 1). Also, due to the fact that her coaching schedule prevents her from attending some professional development sessions, Diane explained that she "would love to go to just a math professional development workshop. [She hasn't] been able to yet…just because of coaching" (Diane, Interview 3, p. 6). In these examples, the contexts that teachers found themselves in influenced their perceived teacher professional development needs. In subsequent sections, the teaching contexts will begin to unfold as a critical aspect of the professional development experiences of the teacher participants. The next section continues the discussion of teacher professional development by offering descriptions of the participants' teacher professional development experiences.

Teachers' Professional Development Experiences

The teachers in this study provided rich descriptions of their professional development experiences. In the sections that follow, these descriptions will be presented as well as the specific teacher professional development activities that the teachers engaged in, followed by a discussion of the teacher professional development activities that the teachers thought had the greatest to least impact on their understandings and perspectives of teacher professional development, content knowledge and theoretical understandings, instructional practices, and students' learning. This section will also describe the teachers' reflections and critiques of their professional development experiences.

Varieties of Teacher Professional Development

The types of teacher professional development sessions that were attended by the teachers in this study varied among those that were conducted as part of their schools' or districts' regular, required professional development, faculty meetings regarding school accreditation, local and regional professional education conferences, off-site workshops sponsored by their schools' intermediate school district agencies, and summer institutes. The time spent at these sessions varied according to type. Regular, required school or district-sponsored professional development and faculty meetings regarding school accreditation were ongoing and generally occurred from a half day to one whole day. Local and regional conferences as well as off-site workshops sponsored by the schools' intermediate school district agencies lasted from one to three days. Summer institutes usually lasted three to five days.

There were three forms of support offered to assist teachers with applying professional development strategies and concepts in their classrooms: support provided by the presenter during a teacher professional development session, follow-up support in teachers' classrooms

after the teacher professional development session, and school and/or district level support. Support provided by the presenter during a professional development session generally took the form of the presenter posing and answering possible questions that students may possibly have when a teacher applies an instructional strategy or concept. As Carter explained, "…I remember him saying, you know students are gonna ask you where this number comes from…" (Carter, Interview 2, p. 6).

Follow-up support encompassed professional developers or coaches visiting mathematics classrooms and providing assistance to both teachers and students. This form of support was especially typical at schools, such as Alice's and Bill's, where the mathematics curriculum included the integration of a mathematics software as an integral component of class lessons (Alice, Fieldwork Reconnaissance, and Bill, Interview 3, p. 7). Although Bill explained this support as being mostly technical to trouble-shoot glitches in the software, he indicated that "she[a professional development coach] will even help the kids in the class" (Bill, Interview 3, p. 7). Additionally, Alice explained another form of follow-up support that occurred after a teacher professional development session when she commented that [professional development presenters/developers] emailed us [teachers who participated in the teacher professional development] worksheets [to use during class lessons]…" (Alice, Interview 2, p. 3).

In addition to support offered during a professional development session attended by teacher participants, and follow-up support to assist with classroom application of strategies, there was also school and district level support characterized by the provision of substitute teachers to cover classes when teachers experienced professional development off site. For example, both Alice and Bill indicated that substitute teachers were used to cover classes at their respective schools when they attended off-site professional development sessions (Alice,

Interview 1, p. 5 and Bill, Interview, 1, p. 9). Conversely, at Carter's and Diane's school, teachers "cover[ed] each other's classes so it's minimal cost to the school" (Carter, Interview 1, p. 9). In fact, Carter indicated that their school was "a little different…than the public schools…public schools are financed through the government to do things just like teacher [professional development]…and we have to take that from our tuition…So I don't think that we have as [many] resources…" (Carter, Interview 1, p. 6). Here, a difference is revealed between Alice's and Bill's urban, public schools and Carter's and Diane's suburban, parochial school with respect to funding for teacher professional development. Additionally, with respect to school and district level support, teacher participants indicated that their school and central level administrators were supportive and encouraging of their professional development (Alice, Interview 1, p. 5; Bill, Interview 1, p. 9; Carter, Interview 1, p. 9, and Diane, Interview 1, p. 21). Thus, teacher participants experienced various forms of support as they engaged in professional development: during a professional development session itself, through follow-up in their classrooms from professional development coaches, and from school and district level administration.

Although some consultants and college professors presented at teacher professional development sessions attended by the teachers in this study, presenters or conveners of the teacher professional development sessions typically came from among other teachers. Some teacher presenters taught at the same school as the participants of this study, while others were from different schools or former teachers. While discussing a one-day regional teacher professional development conference, Carter described the presenters as "fellow mathematics teachers teaching …to each other what their best practices are…" (Carter, Interview 1, p. 7). Additionally, Diane described the presenters at her school-sponsored teacher professional

development session by stating, "…we had several teachers come in from other schools and…we were able to just rotate between…" (Diane, Interview 1 p. 15). Further, while describing presenters, Alice indicated, "They [presenters of teacher professional development] were good. Very good. Former teachers and they know what they were doing." (Alice, Interview 1, p. 5).

The goal of the teacher professional development sessions attended by the teachers was to introduce specific instructional strategies in an effort to enhance or add "better insight" (Alice, Interview 1, p. 4 and Carter, Interview 3, p. 2) into a particular mathematics topic. Further, the ultimate goal or expectation of the teacher professional development was for the teachers to actually apply the instructional strategy that was presented during their teacher professional development in their mathematics class lessons. Bill described this goal and expectation in the following way, "[Presenters would] show you how to do some things on the graphing calculator…and then expect you to go back and kinda maybe try something in your classroom or try something even if you don't get to do [it] in the classroom…think of a lesson that you would do it" (Bill, Interview 1, p. 6). While discussing instructional strategies involving the graphing calculator, Alice explained, "[The presenters of the teacher professional development would] try to get you to see a different perspective…so that when you teach it, you could see it in a different way...and often with the graphing calculator, so we [Alice and participants at the teacher professional development session] had a lot of 'Ah, oh yeah, I see, oh I like that'" (Alice, Interview 1, p. 4-5). Further, while recounting his teacher professional development experiences about reading instructional strategies that could be used in the mathematics classroom, Carter explained, "he [presenter of teacher professional development] really kinda tasked us all with trying a couple strategies like two per quarter is what he's really kinda shooting for" (Carter, Interview 1, p. 7). Additionally, Carter explained "he [teacher professional development

presenter] gave us a book…and one of our things was to find one of the strategies and roll it into our class…" (Carter, Interview 2, p. 12).

The presenters of the teacher professional development sessions encouraged teachers to individually reflect on their use of the strategy or concept in their mathematics classrooms. As Carter explained, "He [teacher professional development presenter] gets us to try these strategies and reflect on them" (Carter, Interview 1, p. 7). Similarly, Alice commented, "…one of the things about the professional development is that…the strategies…you constantly have to reflect on what you taught that you see better ways…" (Alice, Interview 3, p. 6). Additionally, Diane indicated that a presenter asked teachers at her school to reflect on their application of an instructional strategy by "writ[ing] up an evaluation form just so that others [teachers at Diane's school] can see how it worked or how it didn't work…" (Diane, Interview 2, p. 4). These teacher evaluations of the instructional strategy were then placed on a shared email server at the school so that teachers could view one another's evaluation forms of the instructional strategy. Further, Diane indicated that the presenter encouraged them to re-write their evaluation form "so people can see how you changed and adapted what you did" (Diane, Interview 2, p. 4).

The format or manner of organizing teacher professional development sessions provided opportunities for teachers to share their experiences incorporating a particular instructional strategy or concept in their mathematics classrooms. In fact, the format of the teacher professional development sessions included structured opportunities for teachers in this study either to either share their classroom experiences in applying the instructional strategy with other teachers attending the professional development sessions or to present a class lesson that they would plan to eventually use to incorporate the instructional strategy. For example, Alice explained, "We…had the opportunity to…write up some lessons and then share them, and so we

met people from other districts" (Alice, Interview 1 p. 3). Alice further explained group presentations by stating, "They [presenters at teacher professional development sessions] gave each group a problem and [we] had to work on it together and then we would present it, often on some kind of poster paper that we would adhere to the wall" (Alice, Interview 1, p. 4). Likewise, Bill indicated that "…before it's [the teacher professional development session] ended, you are expected to do a lesson with them [other teachers attending the teacher professional development] and present it to the group" (Bill, Interview, 1, p. 6). Bill confirmed that this lesson could either be a lesson that the teacher conducted with their class or a lesson that they planned to conduct (Bill, Interview 1, p. 6). Carter also explained the idea of teachers sharing their experiences regarding the application of an instructional strategy in their mathematics classrooms when he stated, "A session is just sharing best practices, maybe handouts that you do in your class, or the one that we have with the reading, is, here's the book; here's the strategies, 'pick one,' do in your class, There's a rubric to reflect on it and then we come back together and then share" (Carter, Interview 1, p. 17).

Thus, teachers' descriptions reveal two integral components of the teacher professional development experienced by the teachers in this study: 1) teachers working and collaborating in groups with other teachers to solve mathematics problems that could be used in their classrooms, and 2) structured opportunities during the professional development session for teachers to collaborate and share with the other teachers their experiences in using the instructional strategies in their classrooms and/or plans to use the strategy in their classrooms at a later date. These components were further enhanced and accomplished using individual teacher presentations during the teacher professional development session, group presentations during the teacher professional development session, and teacher reflections regarding the application of

an instructional strategy both during a professional development session and after the session, which in some cases were shared electronically among teachers at the same school via shared email communications.

Teacher Professional Development Activities

In addition to sharing, collaborating, and presenting their experiences applying an instructional strategy and/or concept in their classrooms, the teachers in this study engaged in several other types of teacher professional development activities. Table 5 represents a compilation of the teacher professional development activities the teachers experienced.

Table 5 reveals that all of the teacher participants collaborated with teachers about instructional strategies and/or concepts from their respective schools. Additionally, Alice and Carter collaborated with teachers who were not from their respective schools. Bill indicated that the only collaboration that he had was with the special education teacher who taught in his classroom (Bill, Interview 3, p. 11 and p. 14). However, a review of the interviews suggests that Bill also collaborated about instructional strategies and/or concepts with teachers who were not from his school during the teacher professional development sessions he attended. The fact that Diane's coaching schedule prevented her from attending mathematics teacher professional development sessions may explain why she did not have more opportunities to collaborate with teachers not from her school.

A review of Table 5 also reveals that three of the four teachers participated in professional development regarding grading and attendance systems, testing strategies, y-intercept strategies, and graphing calculator activities presented by other teachers from other schools. Further, all of the teachers indicated that they had professional development which involved general activities with the graphing calculator. Except for mathematics software

Table 5. Teacher Professional Development Activities Engaged in by Teacher Participants

Teacher Professional Development Activity	Alice	Bill	Carter	Diane
Collaboration with teachers from same school	X	X	X	X
Collaboration with teachers from another school	X	X	X	
Grading & attendance systems*		X	X	X
Testing strategies		X	X	X
General activities with the graphing calculator	X	X	X	X
Graphing calculator activities by teachers from other schools		X	X	X
General reading in the content area activities			X	X
Reading in content areas/across curriculum by teachers from own school			X	X
Y-intercept strategies**	X	X	X	
Factoring strategies***	X		X	
Specific reading strategy 1*			X	
Specific reading strategy 2*			X	
Use of manipulatives		X	X	
Mathematics software training for class lessons*	X	X		
Web-based information course page			X	X
Interactive white-board training		X		

* The specific name of the instructional strategy is not provided to protect the confidentiality of study participants.
**Y-intercept strategies refer to algebraic technique. For determining where a line crosses the vertical axis of an x-y coordinate plane.
***Factoring strategies refer to an algebra technique where a number is written as a product of numbers.

training for class lessons and interactive white-board training, Carter engaged in all of the teacher professional development activities presented in Table 5.

Impacts of Teacher Professional Development Activities

During the last interview, teachers sorted 16 teacher professional development activities. Here, teacher participants reflected on their learning both before and after their teacher professional development experiences, and sorted the 16 activities according to the greatest to

least impact on their 1) understandings and perspectives of teacher professional development, 2) content knowledge and theoretical understandings, 3) teacher practice, and 4) students' learning. In what follows, tables depict the results of teachers' sortings, with a discussion outlining the teachers' rationale for their characterization of the activities. It is important to note that since Alice was the first interviewee of this study, she sorted fewer professional development activities because additional activities emerged in subsequent interviews. Additionally, teachers could place more than one teacher professional development activity in a given sorting position as they moved through the four aspects studied.

Impact on understandings and perspectives of teacher professional development.

Table 6 displays the results of the teachers' sorting of their teacher professional development activities based on the impact on their understandings and perspectives of teacher professional development. Alice, Bill, and Carter saw collaboration with teachers from their respective schools as having the greatest impact. While sorting, Bill commented "I put this [collaboration with teachers from the same school as the teacher participant] first because this year I do have collaboration, I have a special ed teacher in my room, and so we've done a lot of things in two…of my classes and we've really done a lot of things…" (Bill, Interview 3, p. 14). Alice explained, "…just working with other teachers and learning from them" (Alice, Interview 3, p. 9) had the greatest impact on her understandings and perspectives of teacher professional development. Carter added that "watching our colleagues is really…where we get a lot of our ideas from" (Carter, Interview 3, p. 20). Teacher professional development about testing strategies, however, had the least impact on their understandings and perspectives of teacher professional development. As Diane explained, "…testing strategies weren't really that great of a presentation…[it] was just kind of general information of stuff…it was more just like a waste of

my time" (Diane, Interview 3, p. 14-15). Carter added, "I didn't take a lot away from the testing strategies" and "I've never gotten into using them [testing strategies, y-intercept strategies, and how to use manipulatives]" (Carter, Interview 3, p. 21-22). Similarly, Bill explained that he "really [hadn't] used it [interactive white board]" (Bill, Interview 3, p. 15).

Table 6. Impact of TPD Activities on Understandings and Perspectives about TPD

Teacher	Importance of Teacher Professional Development Activity							
	Greatest							Least
Alice	Collaboration with teachers from same school Collaboration with teachers from another school	Mathematics software training for class lessons						
Bill	Collaboration with teachers same school	Grading and attendance systems	General activities with the graphing calculator	Use of manipulatives	Testing Strategies	y-intercept strategies	Graphing calculator activities by teachers from other schools	Interactive white-board training
Carter	Web-based information course page	Collaboration with teachers from same school Collaboration with teachers from another school	Reading in content areas/ across the by teachers from own school General reading in the content area activities Specific reading strategy #1 Specific reading strategy #2 Factoring strategies	Grading and attendance data systems	Graphing calculator activities presented by other teachers from other schools General activities with the graphing calculator	Testing strategies Y-intercept strategies How to use manipulatives		
Diane	Grading and attendance data systems	Web- based course information page	General reading in the content area activities Reading in the content areas/across curriculum presented by teacher from own school General activities with the graphing calculator Graphing calculator activities presented by other teachers from other schools	Collaboration with teachers from the same school as teacher participant	Testing strategies			

Note: Teachers could place more than one teacher professional development activity in a given sorting position.

Thus, teachers reasoned that their application of instructional strategies in their classrooms impacted their understandings of and perspectives on teacher professional development.

Impact on teachers' content knowledge and theoretical understandings

Table 7 displays how teachers sorted teacher professional development activities based on their impact on mathematical content knowledge and theoretical understandings. Alice, Carter, and Diane rated collaboration with teachers from their respective schools the highest, and Alice and Carter also considered collaboration with teachers not from their schools important to their content knowledge and theoretical understandings. As they explained: "Working with other teachers and asking them questions and being able to debrief is number one…that helps my content knowledge, my theory…" (Carter, Interview 3, p. 25) and "collaboration with teachers…you know got you to know things that they were doing in their classroom" (Diane, Interview 3, p. 16).

Table 7. Impact of TPD Activities on Content Knowledge and Theoretical Understandings

Teacher	Importance of Teacher Professional Development Activity						
	Greatest						Least
Alice	Collaboration with teachers from same school Collaboration with teachers from another school	Teacher professional development not related to mathematics					
Bill	General activities with the graphing calculator	Use of manipulatives	y-intercept strategies	Graphing calculator activities by teachers from other schools	Testing Strategies Interactive white-board training Collaboration with teachers from same school Grading & attendance systems		
Carter	Collaboration with teachers from same school Collaboration with teachers from another school	Use of manipulatives y-intercept strategies factoring strategies Specific reading strategy #1 Specific reading strategy #2	Graphing calculator activities by teachers from other schools General activities with the graphing calculator	General reading-in-the- content-area activities Reading-in-the-content-areas/across curriculum by teachers from own school	Web-based information course page	Testing strategies	Grading & attendance systems
Diane	General reading-in-the-content-area activities Reading-in – the-content-areas/across curriculum by teachers' own school	Collaboration with teachers from same school	General activities with the graphing calculator Graphing calculator activities by teachers from other schools	Web-based information course page Grading and attendance systems Testing strategies			

Note: Teachers could place more than one teacher professional development activity in a given sorting position.

An excerpt from Carter's third interview reveals his thought processes and rationale while sorting the teacher professional development activities from greatest to least impact on his content knowledge and theoretical understandings (Carter, Interview, 3, p. 24):

Carter: Graphing calculators…when I try things on the graphing…I don't teach graphing calculators, but when I like try lessons with the graphing calculators, I personally glean information from that.

SS: Ok

Carter: Alright, so let me see, we got collaborating with the teachers and then we got 3 specific…[Carter did not finish the sentence but is still sorting the index cards.]

SS: Content knowledge and theoretical understandings [SS reminds Carter of the topic of this sort.]

Carter: Content knowledge, ok, so these understandings helped me, yeah these really helped, these strategies [how to use manipulatives, y-intercept strategies, factoring strategies, specific reading strategy #1, and specific reading strategy #2] helped me understand how kids, but is that my understanding? That's not my understanding, but it gives me better insight into what the kids are thinking. So that's um, well…I'd say that's theoretical too. It helps me be a better teacher.

SS: Now the next one is instructional practice.

Carter: Ok. But….this one is theoretical understanding. You could really, you know I could see it going in both. Sibyl…these questions are good Sibyl, you're getting me here!

SS: Thank you.

Carter: Ah alright definitely collaboration by the teachers. That's got to be up there.

SS: Ah ha

Carter: None of this is for content…this is reading knowing how to read, that doesn't do content…these are specific things that other teachers taught me.

SS: Ok

This excerpt reveals Carter's challenge in deciding whether or not some of the teacher professional development activities, specifically the instructional strategies (how to use manipulatives, y-intercept strategies, factoring strategies, specific reading strategy #1, and specific strategy #2) impacted his content knowledge and theoretical understandings or his students' content knowledge and theoretical understandings. Carter ultimately decided that the teacher professional development activities involving the specific instructional strategies which he placed in the second sorting position actually helped both his students' content knowledge and theoretical understandings and his own content knowledge and theoretical understandings by providing him with "better insight into what the kids are thinking" (Carter, Interview 3, p. 24).

Carter further explained the impact of collaboration with other teachers on his content knowledge and theoretical understandings in mathematics while he discussed why he sorted other teacher professional development activities (how to use manipulatives, y-intercept strategies, factoring strategies, specific reading strategy #1, and specific reading strategy #2) and activities involving the graphing calculator as having somewhat less impact. (Carter, Interview 3, p. 25-26).

I then lumped all five of the individual strategies [how to use manipulatives, y-intercept strategies, factoring strategies, specific reading strategy #1, and specific reading strategy #2] that we've talked about on these [index] cards…that's number two 'cause being able to sit there and watch another person tell you how to teach, I mean that's a form of

collaborating. Ah, and every single one of these [(how to use manipulatives, y-intercept strategies, factoring strategies, specific reading strategy #1, and specific reading strategy #2], even if I don't use them in my class, gives me insight into math and how to better think about it and make more connections….even though I don't use all of them. They've all led to my better, deeper understanding of algebra. Um and then I put the two calculators together again cause even though I don't teach it, you know when I use them I…get a deeper understanding when I can graph things and look at intercepts and look at two graphs together on the same plane. I get a better understanding.

Thus, major concepts related to teacher professional development activities are revealed through Carter's statements. First, Carter explains that he thinks a form of collaboration involves watching other teachers demonstrate instructional strategies such as the five strategies which he discussed. Second, the five instructional strategies which he placed in the second sort position as well as collaboration about these strategies through demonstrations by the teacher presenters were perceived by Carter as contributing to his deeper content knowledge and understandings. Additionally, Carter indicated that even if he did not use all of the instructional strategies in his classroom (e.g. activities involving the graphing calculator), they all enhanced his content knowledge and theoretical understandings.

In contrast to Alice, Carter and Diane, Bill sorted collaboration with teachers from his school as having the least impact on his content knowledge and theoretical understandings and ranked general activities with the graphing calculator as having the greatest impact. Not surprising, likely because his collaboration is with a special education and not mathematics education teacher. Testing strategies, activities not related to mathematics, interactive white-board training, and grading and attendance systems were among those activities that were sorted

as having the least impact on content knowledge and theoretical understandings among the teacher participants. Alice summarized activities having the least impact on her content knowledge when she stated, "…if it's not about the math…mute the rest of it" (Alice, Interview 3, p. 9). Additional reasons for placing these teacher professional development activities in the last sorting positions included, "I would say I put...them in this way just for the fact that um these are just more organization skills that really did not improve anything in the content area" (Diane, Interview 3, p. 16) and "…this last position…has more to do with …management than content" (Bill, Interview, 3, p. 15).

Impact on teacher practice.

Table 8 displays the results of the teachers' sorting of their teacher professional development activities based on what they perceived as having the greatest to least impact on their teacher practice. Alice, Bill, and Diane rated general activities with the calculator highest. In fact, Bill sorted the teacher professional development activities in the same order for the impact on his teacher practice as he did for content knowledge and theoretical understandings with the following qualifier, "I'm gonna say they're [sorting order of teacher professional development activities according to impact on teacher practice] the same as the other [sorting order according to impact on content knowledge and theoretical understandings]…but I tell ya, if we actually had one of these [interactive white-board], this would be way up there some place…but we don't have one yet…I mean we have them…we just [are] not going to use them until next year…" (Bill, Interview 3, p. 16).

Table 8. Impact of TPD Activities on Teacher Practice

Teacher	Importance of Teacher Professional Development Activity						
	Greatest						Least
Alice	General activities with the graphing calculator	Teacher professional development not related to mathematics					
Bill	General activities with the graphing calculator	Use of manipulatives	y-intercept strategies	Graphing calculator activities by teachers from other schools	Testing Strategies Interactive white-board training Collaboration with teachers from same school Grading & attendance systems		
Carter	Web-based course information page	Collaboration with teachers from same school Collaboration with teachers from another school	Reading-in-the-content areas/across curriculum by teachers from own school General reading-in-the- content-area activities	Specific reading strategy #1 Specific reading strategy #2 Factoring strategies	Graphing calculator activities by teachers from other schools General activities with the graphing calculator	Testing strategies y-intercept strategies Use of manipulatives	Grading & attendance systems
Diane	Web-based information course page	General reading-in-the-content-area activities Reading-in-the-content areas/across curriculum by teachers from own school	Collaboration with teachers from same school	Grading & attendance systems Testing strategies			

Note: A teacher could select more than one teacher professional development activity for a given sorting position.

Carter and Diane sorted activities involving the web-based information course page as having the greatest impact on their teacher practices. Carter reasoned that "because I'm a technology guy, [web-based information course page] is number one" (Carter, Interview 3, p. 27) and "…for me [web-based information course page] is…huge. [The web-based information course page] has kinda changed the way I teach…I integrate technology into my class…" (Carter, Interview 3, p. 20). In fact, during the first interview, Carter indicated, "I'm kinda the guy who gets to play with all that stuff [technology] first…I'm the one that gets to decide, are we going to give these [technological devices] to kids…is this what kids are going [to] learn now…I kinda get to make these decisions" (Carter, Interview 1, p. 5).

Carter and Diane sorted collaboration with teachers who were from their schools in the highest positions as having an impact on their instructional practices. In the statements that follow, Carter explains how collaboration with other teachers initiated or stimulated the order of his sort as well as how the teacher professional development activities that he experienced are interconnected. (Carter, Interview 3, p. 28)

> So my number two is collaborating with other teachers both in my school and out. And from that I learn my number three which is reading strategies um and …I've applied those in my class in my number four which is specific strategies [specific reading strategy #1, specific reading strategy #2, and factoring strategies]. And that's affected my teaching 'cause I actually use those.

Teacher professional development activities involving testing strategies and grading and attendance systems were sorted by Bill, Carter and Diane as having the least impact on their instructional practices. Reasons for including them in the last sorting positions include "…grading system and …testing strategies will always stay…last 'cause there wasn't anything I

learned from that…" (Diane, Interview 3, p. 16) and "strategies that I don't use …testing strategies" (Carter, Interview 3, p. 28). While testing strategies and grading and attendance systems were not among the teacher professional development activities which Alice had to sort from, Alice indicated again that "things that are not related to math" (Alice, Interview 3, p. 9) had the least impact on her instructional practices.

Impact on student learning.

Table 9 displays the results of the teachers' sorting of their teacher professional development activities based on what they perceived as having the greatest to least impact on their students' learning. Alice, Bill, and Diane sorted collaboration with teachers from their respective schools highest. Bill, who has a special education teacher assigned to his classroom because he has several special education students in his regular mathematics classroom, explained, "…the two of us [Bill and the special education teacher] in the classroom…we play off each other…we've done a lot more, we've got two different teaching styles in there" (Bill, Interview 3. p. 16). As previously referenced, Bill indicated that he does "have collaboration [because he has] a special education teacher in [his room]" (Bill, Interview 3, p. 14). Thus, just as Carter explained that one form of collaboration is watching other teachers demonstrate instructional strategies, Bill offers another form of collaboration which involves the interaction with another teacher in his classroom.

Table 9. Impact of TPD Activities on Student Learning

Teacher	Importance of Teacher Professional Development Activity						
	Greatest						Least
Alice	General activities with the graphing calculator Collaboration with teachers from same school Collaboration with teachers from another school	y-intercept strategies					
Bill	Collaboration with teachers from same school	General activities with the graphing calculator	Use of manipulatives	y-intercept strategies	Graphing calculator activities by teachers from other schools	Testing strategies Interactive white-board training Grading & attendance systems	
Carter	Web-based course information page	Reading-in-the-content areas/across curriculum by teachers from own school General reading-in-the-content-area activities	Specific reading strategy #1 Specific reading strategy #2 Factoring strategies	Collaboration with teachers from same school Collaboration with teachers from another school	Graphing calculator activities by teachers from other schools General activities with the graphing calculator	Testing strategies y-intercept strategies Use of manipulatives	Grading & attendance systems
Diane	General reading-in-the-content-area activities Reading-in-the-content areas/across curriculum by teachers from own school	Collaboration with teachers from same school	General activities with the graphing calculator Graphing calculator activities by teachers from other schools	Web-based information course page Grading and attendance systems Testing strategies			

Note: A teacher could select more than one teacher professional development activity for a given sorting position.

Compared to previous sorts, Carter placed collaboration with teachers who were or were not from his school lower (fourth sorting position). Carter offered insight by saying, "…as far as the students' learning, they don't need me collaborating for them to learn, they need the strategies that I bring for them to learn" (Carter, Interview 3, p. 30). Adding, "Number four, collaboration with teachers both in my school and outside, I get a lot of these ideas from one, two, and three [referring to teacher professional development activities that he placed in the first, second and third sorting positions]…but it doesn't affect the kids as much until I roll them into my class" (Carter, Interview 3, p. 31). Here, Carter highlights the importance of applying specific instructional strategies from the teacher professional development in the classroom, a concept that is further discussed in the next chapter.

Rather than placing collaboration with teachers in the highest positions as in previous sorts, Carter thought that the web-based information course page had the greatest impact on his student learning when he asserted, "[Web-based information course page is] gonna have to be at the top…best chance of impact on learning…because I use videos and they watch me teaching on videos and they can do it anytime anywhere…that's gonna be up there" (Carter, Interview 3, p. 30) and "[Web-based information course page] is number one just 'cause that's who I am and what I do" (Carter, Interview 3, p. 31).

Table 9 also reveals that Alice and Bill thought general activities using the graphing calculator had the greatest impact on their students' learning; while Carter and Diane rated reading across the curriculum presented by teachers from their own school and general reading in the content area activities as having the greatest impact. Alice explained that "grouping may even [be] side by side with [the graphing calculator" (Alice, Interview 3, p. 8). Also, as in

previous sorts among most of the participants, testing strategies and grading and attendance data systems were placed in the last sorting positions for impact on student learning.

Collaboration and teacher professional development.

Collaboration with teachers was a teacher professional development activity that was prevalent across all of the sorts pertaining to the teacher participants' understandings and perspectives of teacher professional development, content knowledge and theoretical understandings, instructional practice, and students' learning. Although collaboration was prominently rated by the teacher participants in these areas, teachers engaged in different forms of collaboration and had varying ideas as to what actually comprised collaboration. For example, Bill viewed his daily work with the special education teacher assigned to his classroom as collaboration (Bill, Interview 3, p. 14); while Carter viewed one aspect of collaboration as observing other teachers model an instructional strategy during a teacher professional development session (Carter, Interview 3, p. 25). Further, Alice described her collaboration as "working and learning from other teachers" and as having a great impact on her beliefs and attitudes (Alice, Interview 3, p. 9). Diane collaborated with teachers at her school about the application of instructional strategies from teacher professional development through a shared email server (Diane, Interview 2, p. 4). Alice also collaborated with her colleagues by email commenting, "I actually emailed this [instructional strategy]. I changed it around a little bit and I emailed it to all my colleagues" (Alice, Interview 3, p. 5). Similarly, Carter used email to regularly collaborate with another colleague at his school stating, "…we're shooting each other articles all the time…and trying to stay up to date in our own fields and…we try to send articles to our colleagues…" (Carter, Interview 3, p. 12). Carter's comments below further illustrate his ongoing collaboration with a colleague at his school. (Carter, Interview, 3, p. 11)

I get a lot from just talking to him. And I try some of these things [instructional strategies] in my class that aren't [from] a professional development session. He knows that I'm up to trying those things, so we do that. And I think also, I'm on the other end…he tries stuff that I give to him and he's checking out websites and doing stuff like that so it's been working both ways. It's almost like a mentoring kind of thing. We're mentoring each other. Now I don't know if that's happening to the same degree with other people and colleagues. I hope it is there…we don't have a mentoring program or there are no checks and balances to say 'Is this teacher trying new things…'

Here, Carter compares his daily collaboration about instructional strategies and concepts to mentoring and considers it important to teachers' professional development.

To a great extent, the various descriptions and forms of collaboration occurred due to the context and circumstances in which the teachers taught mathematics. For example, Bill engaged in collaboration on a daily basis because a special education teacher was assigned to his classroom because of the number of special education students in his classroom stating, "That's why he's [special education teacher] there" (Bill, Interview 3, p. 16). Carter referenced his position in the school as being the person who makes decisions regarding technology as impacting his collaboration with other teachers at his school saying, "I do talk to my other colleagues and he's [a teacher at his school] not the only one, I have some other friends that… look to me to help them with their technology stuff" (Carter, Interview 3, p. 11). Carter also viewed administrative decisions as influencing the frequency in which he collaborated with his colleagues explaining, "You do have to have the time [to meet]…cause it's rare that we're [teachers in Carter's mathematics department] gonna say, 'hey, let's just meet as a math department after school,' that's kind of incumbent upon the administration to carve out that

time" (Carter, Interview 3, p. 7). Similarly, Diane's coaching schedule often limited her opportunities to attend professional development sessions that were specifically focused on mathematics as well as her collaboration with mathematics teachers from other schools. (Diane, Interview 1, p. 14-15). The professional development experiences that Diane did have were due to the required activities that staff engaged in as part of their accreditation (Diane, Interview, 1, p. 13). Here, having adequate time during teachers' work schedules is important to teachers' opportunities to attend professional development offerings as well as engage in collaboration about instructional strategies with their colleagues.

The teachers' contexts not only influenced the forms of collaboration that they engaged in and how they ultimately defined collaboration, but they also impacted their perceptions of how teacher professional development activities impacted various aspects of their teaching. For example, while explaining his rationale for rating the web-based course information page as having the greatest impact on his instructional practice, Carter said, "Because I'm a technology guy, [the web-based course information page] is my number one" (Carter, Interview 3, p. 27). In fact, Carter rated the web-based course information page as having the greatest impact on all except one (content knowledge and theoretical understandings) of the teaching aspects that were rated by the teachers. Also, Alice expressed that because she was a new teacher, she needed more professional development that focused on mathematics instructional strategies commenting, "being only a teacher for a year and a half, [teacher professional development] is picking up things that help me to teach something. Just because you know how to do it [and] you know the concept, doesn't mean you can teach it" (Alice, Interview 2, p. 4). Further, Bill indicated that he would have rated the interactive white board training higher as having an impact on his instructional practice if he was actually able to use it saying, "…if we actually had

one of these [interactive white board], this would up there someplace [in the sort on instructional practice]…but we don't have one yet….I mean we have them, we [are] just not going to use them until next year..." (Bill, Interview 3, p. 16).

Teachers' Reactions to Teacher Professional Development Activities.

In addition to rating their professional development activities, the teacher participants discussed their reactions to these professional development activities as well as their perceptions of the attitudes of other teachers regarding professional development. The teacher participants made positive comments regarding the teacher professional development activities that they experienced (Carter, Interview 3, p. 5, Diane, Interview 1, p. 18, Alice, Interview 1, p. 6, Bill, Interview 2, p. 7). For example, Alice commented that when she and the other teacher participants at a professional development session "had to present something…it was really nice, because [she] did one on probability, someone did something else, and we've been able to take that to our bag of tools" (Alice, Interview, 1, p. 3). Similarly. when describing group presentations, Bill indicated, "Some [of the teachers at the professional development session] would have suggestions as to how to switch it to make it better…so you know it was very nice" (Bill, Interview, 2, p. 7). When describing his teacher professional development experiences, Carter indicated, "I've always been able to go there and at least glean something that I could try" (Carter, Interview 3, p. 5).

Even though the teachers commented positively about their own professional development experiences, they had less than positive remarks about the attitudes of some of their peers regarding professional development. For example, Alice commented,

> I want to go through a professional development and give them [my] all, unfortunately, I have to say…regardless of where I was…half of the people don't have that

attitude…Some people don't want to be there and…you're dealing with that as you're

sitting in it. (Alice, Interview 1, p. 3)

Similarly, Carter stated, "…I could probably count on one hand the number of teachers that I

know of [who] find things [professional development offerings] and I can count on two hands

and my toes, the ones [teachers] [who] don't go [to] conferences" (Carter, Interview 1, p. 9).

Further, Carter expressed that he was "frustrated with [his] math department because I don't feel

that everyone in my department is as willing as I am to try new things" (Carter, Interview 3, p.

10). Carter quickly qualified this statement saying, "Now to their [teachers in Carter's

mathematics department] credit, when we did these [reading instructional strategies]…they

[teachers in Carter's mathematics department] all tried different strategies, we met, I'd like to do

more of that…but again, there's not a lot of time…so there has been some frustration trying to

share it with colleagues" (Carter, Interview 3, p. 10).

The teacher participants suggested that some of the teachers' negative attitudes toward

professional development are due to them not wanting to change their instructional practices. For

example, Diane concluded, "I think that there are some teachers who are just content being

where they are" (Diane, Interview 1, p. 14). Similarly, Alice commented, "…a lot of times,

teachers [who] have been teaching for a long time…they'll say, 'Oh God, why am I here?'"

(Alice, Interview 3, p. 3). Carter also shared this sentiment regarding the unwillingness of some

teachers to change saying, "…around the water cooler, it [teacher professional development] gets

talked down…because the teachers aren't willing to change what they've done" (Carter,

Interview 1, p.5) and "…they don't want to be told that anything could be new or could be

different" (Carter, Interview 1, p. 5).

Bill and Diane thought that teachers' negative reactions toward professional development stemmed from them not seeing a connection to their classrooms. For example, Bill stated, "I think sometimes teachers get down on professional development because they go to these developments and they don't see a use for it or the application for it" (Bill, Interview 3, p. 4) and "As soon as you see that's not going to link up, people tune right out" (Bill, Interview 1, p. 5). Diane also shared this reasoning commenting, "I remember hearing a few of them [who] just hated it…[they] didn't know how to connect them [information from teacher professional development]…actually making it apply for them in class…" (Diane, Interview 2, p. 17). Here, teachers' views of how professional development can be implemented into the classroom influences their general attitude toward teacher professional development. The next chapter discusses the application of teacher professional development through descriptions of how the teachers in this study applied instructional strategies and concepts from their professional development experiences in their classrooms.

CHAPTER 5

TEACHER APPLICATIONS AND OUTCOMES OF PROFESSIONAL DEVELOPMENT

Teacher participants were asked to demonstrate a lesson which best displayed how they applied an instructional strategy and/or concept from their professional development in their classrooms. This chapter begins with a description of these lessons and moves to a discussion about how the teacher participants modified and adjusted the professional development strategies to work in their classrooms. The last part of this chapter commences a discussion of the outcomes of teacher participants' with respect to teacher learning, changes in instructional practice, student learning, and professional learning communities which were found to exist among teacher participants.

Description of Teacher Participants' Application of Professional Development

Table 10 shows the instructional strategies and concepts that were demonstrated by the teachers and how they applied them. Here, teacher participants incorporated different instructional strategies from their professional development experiences into their classroom lessons to accomplish various objectives. Alice and Carter incorporated their strategies by having students work together in groups to complete problems and exercises followed by presentations of their work to their classmates. As Carter described, "…they [students] [are in] small groups…it's a group exercise…they [students] discuss…they [students] come up with a consensus" (Carter, Interview 2, p. 7-8) and "they [students] have to defend their point of view to their peers" (Carter, Interview 2, p. 12).

Table 10. Teacher Participants' Application of TPD Strategies in their Classrooms

Objective of Lesson	Instructional Strategy/Concept from Teacher Professional Development	Classroom Application of Instructional Strategy/Concept	Did Teacher Participant Modify during application?
"Introduce the concept of inverse to see how it looks physically before they [students] manipulate the equations" (Alice, Interview 2, p. 2)	Teachers worked together in groups to complete x-y charts. Graphed equations of lines. Posted and presented answers to other teachers at professional development session.	Algebra: Students worked in groups. Completed x-y charts. Graphed equations of lines. Posted answers on wall. Presented answers to other classmates.	Yes
"Use the graphing calculator to show [how] differences in the formulas for a parabola result in a different graph" (Bill, Interview 2, p. 1) "Introduce what a parabola looks like" (Bill, Interview 2, p. 3) Explain odd and even function[s]" (Bill, Interview 2, p. 4)	General activities with the graphing calculator	Pre-Calculus: Bill asked students questions about graphing calculator. Students completed graphing calculator activities.	No
"Allow students to learn a fairly simple [concept] early on and then repeat that concept over and over [so] they become familiar with it." (Carter, Interview 2, p. 2)	Factoring instructional strategy	Algebra: Carter asked students questions. Students used factoring strategies to solve problems.	Yes
"Access their [students'] prior knowledge" (Carter, Interview 2, p. 9) "Help them [students] understand the vocabulary better by accessing prior knowledge" (Carter, Interview 2, p. 13)	Specific reading- in-the-content-area strategies	Student worked in groups. Completed reading-in-the- content-area activities. Posted answers on wall. Presented to classmates.	Yes
"Get them to read before [I] actually teach the lesson, look for different things, to organize the information from the chapter…in a simple manner" (Diane, Interview 2, p. 10-11) "[Students] can use to quiz [themselves]." (Diane, Interview, 2, p. 2)	Reading-in-the content-areas/across curriculum activity	Algebra: Students used reading in the content area activity during class lessons.	Yes

As Alice described the group activity in which x-y charts were used to graph equations of lines:

Alice: Well actually this was a group project...there were like 5 or 6 different equations, I think [that] I did the…easiest 1 or 2 on the board and they [students] filled them in. Then, there [were] 4 or 5 groups and I assigned each one of them [equations]…and they were to take it from the worksheet, they had to complete the whole worksheet. But in their presentation, I gave them like fifteen minutes to complete the worksheet, because at this point, they could have used their calculators. We did a few by hand [x-y charts], but eventually, once the equations of line got a little bit more complicated, they could use their calculator, key it in, and then just copy the chart and then graph it. So each group had to take what was on the sheet and blow it up on one of these…easel paper with a sticky back on it so it goes up on my [wall]. They'd do all of this: write the equation, write the inverse, show the charts, draw the picture, and then they had to manually manipulate and show me how they came up with the inverse.

SS: And they presented this to the class?

Alice: Yeah. And that's when the other students kinda checked their other answers.

SS: So [is] that [a]… strategy that you learned [from] the professional development?

Alice: Right. Almost everything that we [Alice and teachers at her professional development session] did…not everything, but almost everything, we were in groups and had to do presentations.

 (Alice, Interview 2, p. 2)

Here, there was an alignment of how the strategy was presented during Alice's professional development (working with other teachers in groups) to how Alice applied it in her classroom through students' group work and presentations.

Students of the teacher participants asked minimal questions during the lessons in which the professional development strategies were incorporated. In fact, their questions generally involved how to actually use the strategy or activity as a method to help them solve assigned problems and complete class assignments. As Carter revealed, "Well, their [students'] questions [were] based on where [to] put [the] numbers…so they weren't clear on…which term [to] put here, here, and here [while using the factoring strategy]" (Carter, Interview 2, p. 4-5). While describing his students' questions in lessons incorporating instructional strategies with graphing calculators, Bill commented, "A lot of students have problems more with the technology than they do with what you're [the teacher] [is] doing" (Bill, Interview 2, p. 6). Additionally, Diane described her students' questions during the lesson incorporating the reading in the content area strategy that is reflected in Table 6 as "introductory type questions" (Diane, Interview 2, p. 15) related to how to utilize the strategy to help them complete an assignment and "by the fourth [or] fifth time, [there] [were] not as many as those type[s] of questions" (Diane, Interview 2, p. 15).

To varying degrees, the teacher participants made decisions and modifications as they moved strategies from their professional development experiences into their classrooms. For example, Diane indicated that she changed the reading strategy (referenced in Table 6) that was designed to assist students to study major content area points because she "realized that they [Diane's students] didn't really…use it to quiz themselves" (Diane, Interview 2, p. 2). Also, when describing the use of an instructional strategy while students worked with each other in groups, Alice explained:

I don't have them [students] looking at each other 'cause there is a lot of board work. So I have the desks, so [that] 2 are this way and 2 are facing this way, so all the [students] on

the side can just turn their head [to view the board]. So they can work in groups and look

on the board. (Alice, Interview 3, p. 3)

When describing his experience with using a specific reading strategy with his students, Carter

said, "I'll preface this by saying, I didn't do that [instructional strategy] with the elementary

kids…I did it with the regular algebra [students] because I thought they…would be able to

handle it…" (Carter, Interview 1, p. 8). Further, Carter summarized how he made decisions

during classroom implementation of strategies saying, "I'll try this [specific reading strategy] on

this lesson and then this one [specific reading strategy], I'll try the other one [specific reading

strategy] that [professional development conveners] showed me and which one [specific reading

strategy] works the best, I'll apply that to the third one [lesson]…" (Carter, Interview 1, p. 17).

Similarly, Alice explained her thought processes regarding classroom application of professional

development strategies and concepts:

> Well, I think that one of the things about the professional development is that the
>
> strategies…I think that in hindsight…you constantly have to reflect on what you taught
>
> [so] that you [can] see better ways [to teach]. After I teach it one way, I might see better
>
> ways to teach it next time…and sometimes you can even say, 'Well I did this [lesson]
>
> this way, but maybe I can even apply it [the instructional strategy] to this other [content]
>
> strand. (Alice, Interview 3, p. 6).

Likewise, Diane described her modification of using the interactive white-board in her classroom

as "trial and error and playing around with it [interactive white-board]" (Diane, Interview 2, p.

8). Thus, the teacher participants were willing and comfortable in their teaching contexts to try

out professional development strategies with their students, and teachers engaged in continuous

reflection and evaluation to modify the strategies for effective use in their classrooms, a hallmark of master teachers.

All of the teacher participants made decisions to modify an instructional strategy based on what they thought were in the best interests of their students' learning. For example, Alice commented on the use of an instructional strategy saying, "Even though it's a great tool, I've got to develop it myself in the best way for my students" (Alice, Interview 3, p. 5). Likewise, Diane indicated, "…there [are] so many ways you can use it (reading in the content area/across curriculum strategy), so it's just kinda figuring out what works best" (Diane, Interview 2, p. 7). Carter explained his decision not to use a professional development strategy in his classroom in the excerpt below (Carter, Interview 3, p. 9).

> I flirted with the idea about bringing that [professional development instructional strategy] into my classroom. But then I thought, 'I don't need [this professional development instructional strategy]…my personality is such that I have fun with the kids without that [professional development instructional strategy].' But it [professional development instructional strategy] causes me to think…that I shouldn't forget to…have fun. I didn't take it and roll it into my class, but it [professional development instructional strategy] caused [me] to reflect and reaffirm what I was already doing.

Here, professional development strategies are not necessarily implemented into the classroom; but serve as a way for teachers to reflect on and validate their current instructional teacher practices.

The following narrative reveals how Bill modified an instructional concept by providing additional explanation to help one of his students (Bill, Interview 1, p. 8-9).

It's [mathematics software program on computer] got some good sides and it's got some bad sides. There's some real frustrating things and…as an example, today in Geometry, [a student] came up and wanted some help on a 30-60-90 triangle. I looked at the information that was given and I advised him on something. We worked out the answer and were wrong and I [said], 'Ok, I'm gonna tell you something, [Bill] isn't wrong, [Bill] is right. The computer is wrong and I'm going to tell you why [it's] wrong. Because when [the mathematics software on the computer] label[s] the triangle…Triangle ABC is a 30-60-90 triangle and then [the mathematics software on the computer] [draws] a picture of it. The way [the mathematics software on the computer] described it, [the mathematics software on the computer] had given you the small side. The way [the mathematics software on the computer] drew it, [you were given] the big side with the big label.' In geometry, we always tell students not to judge things based on pictures, but based on information…you should have been able to do this problem without a picture…they're [the mathematics software program] telling you 'look at the picture, don't look at this here [information about the triangle].' So, I said, 'I'm not really thrilled with [the mathematics software on the computer] but we'll let it slide, now we know what to do with that.'

The narrative analysis below outlines the problem that Bill encountered while using the mathematics software with students by dividing the above excerpt into four major components: abstract or summary of situation, orientation, complicating action, and resolution.

Abstract

01 It's [mathematics software program on computer] got some good sides and it's got some bad sides. There's some real frustrating things

Orientation

02 as an example, today in Geometry, [a student] came up

03 and wanted some help on a 30-60-90 triangle.

04 I looked at the information that was given

05 and I advised him on something.

Complicating Action

06 We worked out the answer and were wrong

07 and I [said], 'Ok, I'm gonna tell you something, [Bill] isn't wrong, [Bill] is right.

08 The computer is wrong and I'm going to tell you why [it's] wrong.

09 Because when [the mathematics software on the computer] label[s] the triangle…Triangle ABC is a 30-60-90 triangle

10 and then [the mathematics software on the computer] [draws] a picture of it.

11 The way [the mathematics software on the computer] described it, [the mathematics software on the computer] had given you the small side.

12 The way [the mathematics software on the computer] drew it, [you were given] the big side with the big label.'

Resolution/Coda

13 In geometry, we always tell students not to judge things based on pictures, but based on information…

14 you should have been able to do this problem without a picture

15 they're [the mathematics software program] telling you 'look at the picture, don't look at this here [information about the triangle].'

16 So, I said, 'I'm not really thrilled with [the mathematics software on the computer]

17 but we'll let it slide …

18 now, we know what to do with that.'

Thus, Bill resolved the student's inquiry by reminding the student of previously taught content information about 30-60-90 triangles that should be used or applied in this situation. In addition to sharing how they modified professional development strategies to make them work in their classrooms, teachers provided additional reflections on how well the strategies worked in their classrooms which are discussed in the next section.

Teacher Reflections on Professional Development Application

The teacher participants positively described their experiences in applying the professional development strategies in their classrooms. For example, when describing the use of a specific reading strategy in his class, Carter reflected that he "liked hearing [his students' responses]" while using the strategy in his class (Carter, Interview 2, p. 17). Also, Alice reflected on the factoring strategy applied in her class in the excerpt below. (Alice, Interview 3, p. 6)

They [Alice's students] understood it [factoring strategy]. It [factoring strategy] was something…[that] they [Alice's students] could fill in and factor out…not having the [factoring strategy] they didn't know where to go with their steps where here the [factoring strategy] helped them recall the steps faster.

Diane also reported positive experiences with the application of a reading-in the-content area strategy in the excerpt below. (Diane, Interview 2, p. 14)

I think it [reading-in-the-content area strategy] helped just to have the kids come in with some prior knowledge of what we're doing...and not just…completely coming in blind and saying, 'Ok, she's just going to teach me what I need to know and I'll do my

homework and move on'…[the reading in the content area strategy] was…getting some accountability for them [Diane's students].

All of the teacher participants referred to the professional development strategies as *tools* to help them accomplish various objectives and tasks with their students. For example, Diane, who was unable to attend the formal training on the interactive white-board and learned on her own how to utilize it, explained, "its [interactive white board] just a nice tool for things…" (Diane, Interview 2, p. 9). Also, Alice described instructional strategies from her professional development saying, "We've [teachers at Alice's professional development session] been able to take that [instructional strategies shared by other teachers at Alice's professional development session] to our bag of tools" (Alice, Interview 2, p. 3). Similarly, Carter explained, "a lot of it [algebra professional development] is tools…what tools can we [teachers] learn" (Carter, Interview 1, p. 10) and "…I added that [factoring strategies] to my toolbox" (Carter, Interview 3, p. 1). Finally, Bill described strategies and activities using the graphing calculator to complete exercises "as a good tool" (Bill, Interview 1, p. 3).

Thus, with varying degrees of modification, teachers experienced success in using professional development strategies with their students. During application of these strategies, the teacher participants made decisions which were in the best interests of their students' learning, an outcome of their professional development. In addition to student learning, there were other outcomes of professional development implementation such as teacher learning and changes in instructional practice. The next section begins this discussion regarding the outcomes of professional development which occurred in the contexts that teachers taught mathematics and the contexts in which they experienced their professional development.

Teacher Professional Development Outcomes

As the teacher participants described their professional development experiences in their respective teaching contexts and how they applied professional development strategies and concepts in their classrooms, three major outcomes became apparent: teacher learning, student learning, and changes in instructional practice. This section provides insight into these outcomes and ultimately reveals how teacher professional development activities begin to shape teacher practices to become like those typically found in and among members of professional learning communities.

Teacher Learning from Incorporating Strategies

The teacher participants described their learning from professional development experiences in terms of acquiring knowledge of new instructional strategies. For example, Diane indicated that she "…gained…additional knowledge of different options [reading-in-the-content-area instructional strategies] that were available…[and] how to make them actually applicable in the classroom" (Diane, Interview 3, p. 3-4). Adding, "…we were given different ideas of how to use it [reading-in-the-content-area strategy]" (Diane, Interview 3, p. 4). Also, Alice indicated that "Being a teacher for a year and a half [teacher professional development] is picking up things that help me to teach something. Just because you know [the concept]…doesn't mean you can teach it" (Alice, Interview 2, p. 4) and "I have learned something from everyone [other teachers in Alice's professional development experiences]…I do learn from all the others [teachers in Alice's professional development experiences]" (Alice, Interview 3, p. 4). As Bill explained his learning of new instructional strategies (Interview 3, p. 1):

I've gone to a couple of [teacher professional development sessions] and my understanding of the graphing calculator was very limited. I assumed it [teacher

professional development session] had something to do with graphing and then when you

go through it [teacher professional development session], you see a lot of different things

that it [graphing calculator] can do, you start to see different ways you can apply it.

Thus, teachers not only learned new instructional strategies from their professional development experiences, but also learned multiple ways that a given strategy could be used in their classrooms.

While discussing a professional development strategy involving factoring, Carter revealed that he "had knowledge of other strategies, but it [factoring strategy] was a new strategy so I learned something brand new…it [factoring strategy] was a new way to do it that I had never learned and so that was completely brand new" (Carter, Interview 3, p. 1-2). In addition to learning new instructional strategies, Carter explained his learning with regard to content knowledge and theoretical understandings:

Every single one of these [instructional strategies from Carter's professional development], even if I don't use them in my class, gives me insight into math and how to better think about it and make connections. (Carter, Interview 3, p. 25)

Even though I don't use all of them [instructional strategies from Carter's professional development], they've all led to my better, deeper understanding of algebra. (Carter, Interview 3, p. 25)

So it [factoring strategy] really cemented my knowledge of these concepts: factoring, foiling, distributing, long division, complex division and synthetic division and how all of these were intertwined. (Carter Interview 2, p. 3)

Not only are Carter's content and theoretical understandings deepened with the knowledge of new instructional strategies, they are deepened without actual classroom application. Here again,

as previously highlighted, professional development strategies do not necessarily have to be implemented in the classroom to influence teacher learning, among other things.

Some teacher participants' learning, however, occurred either during or after they tried the new strategy with their students. For example, when discussing her students' working in groups, Alice commented, "…the group working [among students] has allowed me to develop more of 'What else can I do in the group? Where can I combine the group work, and individual and whole group altogether?'" (Alice, Interview 3, p. 3). Here, knowledge of new instructional strategies combined with classroom implementation to produce additional ideas about how the strategy could be used. Additionally, Bill commented, "…you don't get to learn it [instructional strategies using laptops] by just one day, you gotta' go back and do it" (Bill, Interview 3, p. 6). And, Carter made theoretical connections after he incorporated the strategy in his classroom (Carter, Interview 2, p. 3):

> I didn't put the connection between all those concepts together as well…until I started doing it [factoring] this way [using the factoring strategy]. To me the idea of the middle term being made up of these factors along this diagonal and these factors being like terms…I had known about it in kind of a cursory way, but it didn't make concrete sense until I started doing this [using the factoring strategy].

Additionally, a student's question during the application of a specific reading strategy in Carter's mathematics classroom helped him to make deeper connections to the content being taught (Carter, Interview 2, p. 17-18):

> Someone [a student] said, 'How is this [a mathematics topic] used in medicine?' I never would have thought to make any connection at all. But now, if I come across anything in any one of [the] lessons, it might jog my memory and look right at that [student] and just

say that, so now that [student] can say, 'Ok, this applies to a question that I had in life.'
It's not a big thing…but I'm at least making connection to something that we learned in
my class to a piece of knowledge that she wanted to know.

Here, the application of professional development strategies provided opportunities for deeper
theoretical understandings for both teachers and students. As such, these findings highlight the
fact that teaching itself is a learning profession, one where the practice of teaching deepens the
content conceptual knowledge and the pedagogical knowledge of teachers. Here, teacher
professional development plays a key role in teachers' being learners in all facets of their
teaching practice, not just in teacher professional development activities themselves. And,
teacher professional development strategies influenced student learning.

Student Learning as a Result of Teacher Professional Development Activities

The teacher participants described their students' learning in terms of their students'
ability to effectively use professional development strategies to help them solve mathematics
problems and complete other class assignments. For example, Bill thought that strategies
involving the graphing calculator helped his students to solve harder graphing problems saying,
"…you can get away from always having nice whole numbers…like $y = 2x + 8$…and here [using
the graphing calculator] it isn't any more difficult for them to graph with [other] kinds of
numbers" (Bill, Interview 3, p. 9). Also, Alice commented that her students developed a
good…rhythm of [using] [the] factoring [strategy] (Alice, Interview 3, p. 2). Further, Alice
emailed a factoring instructional strategy from her professional development to other teachers at
her school and found that when a student was moved to her classroom due to the layoff of a
teacher, the student "remembered it [the factoring strategy]" (Alice, Interview 3, p. 6). Adding,
"So that was good…that tells me that maybe it's [factoring strategy from teacher professional

development] a good way to teach it" (Alice, Interview 3, p. 6). Here, the professional development strategy which Alice shared with other teachers at her school remained in a student's skill set as the student moved from one teacher to another. Additionally, when describing her students' learning while using a reading-in-the-content-area strategy obtained from professional development, Diane commented that her students "used it [reading-in-the-content-area] a lot" (Diane, Interview 2, p. 6); however, she didn't "necessarily think that students had [additional] learning" (Diane, Interview 3, p. 10) and that "it [reading-in-the-content-area strategy] was just a different organizational skill for them" (Diane, Interview 3, p. 10). Thus, while Alice counted a particular factoring strategy a learning, Diane short-changed her students' skills and did not count the reading-in-the-content-area strategy as bona fide learning, in spite of the fact that students' use of it seemed related to their learning other content.

Finally, when describing student learning after incorporating professional development strategies that he learned in his classroom, Carter expressed that it was "really hard for [him] to know if [instructional strategies from professional development] enhances their [students'] learning" (Carter, Interview 3, p. 13). Adding, "there's a better chance that it [instructional strategies from professional development] could impact their learning…a lot of times that's really all we can do is have a better chance to impact their learning and find where it connects one or more kid[s] or something like that" (Carter, Interview 3, p. 14). Carter concluded by saying that the professional development strategies used with his students were ways of "connecting a prior knowledge to a concept [that] [they] were [currently] learning" (Carter, Interview 2, p. 2) and that the "[professional development strategies] allow them to use that prior knowledge…[as] a familiar place to begin to learn the concepts" (Carter, Interview, 2, p. 3). Thus, teacher learning involved the knowledge of new instructional strategies, some of which

became apparent to teachers after they actually used the strategy with students, while student learning was characterized by the teacher participants as a foundation to better understand upcoming concepts, a method to organize course content, and a way to solve more rigorous course content. Professional development outcomes also influenced to teacher practice.

Teacher Professional Development Influences on Teacher Practice

I want to be better…I think honestly, I change the way I teach every year. I'm always trying to find something new, something engaging, something that will just connect things to them [students]. (Carter, Interview 1, p. 4)

…every year that I go to it [professional development conference], I get something that I've been able to roll into my class. In fact, just this year, I actually changed the way that I taught a certain concept because of that conference…completely changed it. I teach it a new way now. (Carter, Interview 1, p. 7)

Like Carter, teacher participants integrated strategies they learned from their professional development experiences into daily instructional practices. For example, while discussing the impact of incorporating a factoring strategy in her classroom, Alice indicated, "I may not have taught it in that way initially, but now I…use it [factoring strategy] in my instruction" (Alice, Interview 3, p. 2). Alice added that she tries to use strategies from her teacher professional development "whenever [she] can" (Alice, Interview 1, p. 8). Diane incorporated strategies from her professional development experiences into her instructional practice saying, "I adapted them [reading in the content area strategies] over time, because I've been doing them three quarters now" (Diane, Interview 2, p. 1). Further, Bill maintained that the graphing calculator strategies from his professional development "make [his instruction] far easier…[and] allows [him] to do not just slightly more, it allows [him] to do a lot more graphs" (Bill, Interview 2, p. 6). Adding,

…it use to take so long to [graph] one parabola…here you can do so many of them so fast…I could show them 20 [graphs] and they can [graph] 20 parabolas in 20 minutes or less (Bill, Interview 2, p. 6).

TPD's Impact on Teachers' Readiness for Professional Learning Communities

Teacher participants engaged in a wide range of actions (in their classrooms and in teacher professional development contexts) that suggest their readiness for becoming members of professional learning communities. In fact, some of these actions, and their contexts, illustrate ongoing instructional practices and routine interactions among teacher participants. Organizing these actions and contexts according to the National Staff Development Council's (NSDC) context, process, and content standards of professional development, teachers' actions and contexts mirror practices and concepts found to describe members of professional learning communities. As such, these actions and contexts provide a way to articulate the teacher participants' readiness to become members of a professional learning community.

A componential analysis of teachers' actions and contexts found differences among the teachers in terms of the type of readiness (context, process, and content) they exhibited to become members of a professional learning community and when it occurs (ongoing, before, during, or after the teachers' professional development experiences) Table 11). Recall from Chapter 2 that *context* standards refer to the organization and structures in which teacher professional development takes place, *process* standards refer to how teacher professional development should be implemented, and *content* standards refer to what information and knowledge teacher professional programs and activities will contain. (NSDC, 2001). In fact, although the componential analysis revealed a relatively even distribution of teacher actions and situations among the teacher participants – categorized as context, process, and content readiness

Table 11. Teacher Participants' Readiness to be Members of Professional Learning Communities

CONTEXT STANDARDS	Alice	Bill	Carter	Diane
Willing and comfortable trying new instructional strategies from professional development experiences in their classrooms	X + o	X + o	X + o	X + o
Exposed to new instructional strategies at regularly scheduled school improvement/accreditation meetings			X o	X o
Experienced TPD that provided structured opportunities for teachers at same school to collaborate about TPD strategies	X +	X = o	X = + o	X = +
Experienced TPD that provided structured opportunities for teachers from different schools to collaborate about TPD	X =	X =	X =	
Makes decisions for their school regarding technology use for student learning			X o	
Used email as a way to collaborate, reflect on, evaluate, and share strategies with teachers from same school and/or teachers from different schools (Add note re Alice)	X +		X + o	X +
Helped to develop a pacing guide with other teachers at same school for Algebra course to increase expectations [of students]	X ^			
Tried to improve students' opinions of themselves that they could be successful in mathematics				X o
Taught at a school where time was a challenge with respect to organizing and participating in TPD			X o	X = o
Taught at school where administrators were supportive of teachers attending TPD sessions	X o	X o	X o	X o
Taught at school where there was external support for classroom implementation of TPD strategies for specific mathematics curriculum	X + o	X + o		
Taught at school where substitute teachers were used to teach classes when teachers attended TPD sessions	X o	X o		
Taught at school where teachers covered each other's classes so that teachers could attend TPD sessions that were off the school's site			X o	X o
Participated in TPD that expected a team of teachers from the same school to attend TPD sessions		X ^ =		
Regularly observed another teacher's instructional practices at their school			X o	
Participated in a group decision at school with other mathematics teachers to incorporate a strategy from TPD in classes			X +	

^ Before TPD   = During TPD   + After TPD   o Ongoing

Information in parentheses indicates some teacher actions associated with more than one type of PLC readiness (context, content, process)

(Table 11, continued)

PROCESS STANDARDS	Alice	Bill	Carter	Diane
Regularly observed another teacher's instructional practices at their school			(X o)	
Applied, modified and adapted teacher professional strategies to work in classrooms	X + o	X + o	X = o	X + o
Engaged in formal and informal evaluations and reflections regarding TPD application in classrooms	X + = o	X + = o	X + = o	X + = o
Uses student achievement data to evaluate effectiveness of TPD strategy	X +			
Initiated and facilitated their own TPD	X o	X +	X o	X o
Requested worksheets from TPD session for classroom use	X =			
Took benchmarks to use during TPD session		X ^ =		
Changed teaching practices after TPD application in classroom	X + o	X + o	X + o	X + o
Instructional strategies obtained from TPD experiences stimulated teachers' ideas for other applications of TPD strategy in classrooms	X +	X +	X +	
Experienced TPD that deepened teachers' content knowledge and theoretical understandings	X =	X = + o	X + o	
Content of TPD and TPD activities aligned teacher learning with student learning				
Experienced TPD that could help students to solve more difficult mathematics problems	X = + o	X = + o	X = + o	

CONTENT STANDARDS	Alice	Bill	Carter	Diane
Presented to and learned new strategies and ways to apply TPD strategies with and from teachers from the same school			X = o	X = +
Presented to and learned new strategies and ways to apply TPD strategies with and from teachers from the different schools	X =	X =	X=	X =
Recognized, articulated, and fulfilled individual TPD needs	X o		X o	X o
Experienced TPD that deepened teachers' content knowledge and theoretical understandings	(X =)	(X = + o)	(X + o)	
Content of TPD and TPD activities aligned teacher learning with student learning	X = +	X = +	X +	
Experienced TPD that could help students to solve more difficult mathematics problems	(X = + o)	(X = + o)	(X = + o)	
Participated in TPD that extended and involved other subjects and topics than mathematics	X o	X o	X o	X o
Participated in TPD that encouraged and expected classroom application of instructional strategies presented during TPD	X = +	X = +	X = +	X = +
Participated in TPD that encouraged teachers to facilitate their own learning		X = +	X = +	X = +
Participated in TPD that required participants to present and share lessons and problems	X =	X =	X =	X =

^ Before TPD   = During TPD   + After TPD   o Ongoing

Information in parentheses indicates some teacher actions associated with more than one type of PLC readiness (context, content, process)

for professional learning communities; a few notable differences existed. For example, Diane had the lowest number of actions and contexts among the teacher participants. This likely came from her athletic-team coaching schedule, which prevented her attending many professional development opportunities. As described earlier, Diane minimized this limitation on context by often facilitating her own learning and development via subscribing to professional learning magazines and email communications (Diane, Interview 1, p. 26).

Conversely, Carter had almost twice the number of ongoing actions and contexts as other teacher participants, with the majority of these ongoing actions and contexts classified as context and process readiness for professional learning communities. But, Carter had a slightly lower number of actions and contexts, occurring during a professional development session or experience, while Bill had the highest. Here, the majority of Bill's preparation and experience to be a member of a professional learning community originated from actions and situations directly related to (or during) a teacher professional development experience, while Carter's readiness grew from his ongoing actions and non-teacher professional development contexts in which regularly engaged. An example that best illustrates the ongoing nature of Carter's actions and contexts concerns Carter's regular collaboration during the school day around professional development topics and strategies, especially with a mentor teacher at his school, and this exemplifies Carter's professional learning community readiness relative to ongoing actions and contexts. As he described mentoring: "We're each mentoring each other" (Carter, Interview 3, p. 11) and "[h]e [teacher at Carter's school] knows I'm up to trying those things [professional development strategies and concepts]" (Carter, Interview 3, p. 11).

However, though these four teachers demonstrated readiness for professional learning community membership, the roots of their readiness differed, as did the quality or sort of

professional learning community each might find a good fit. In fact, teacher participants seemed, to some extent, already functioning as members of different professional learning communities at their schools and through the contexts where they experienced professional development. Let us turn then to the types of professional learning communities existing for teacher participants.

Types of Existing Professional Learning Communities Found in Study

The teacher participants engaged in professional learning community actions and contexts while interfacing and collaborating with other teachers, both from their own schools, and from other schools and organizations. These collaborations formed six types of professional learning communities that consisted of a varying number of teachers, occurred in different ways, and served distinct objectives with the primary goal of enhanced and improved student learning. Table 12 displays the types of professional learning communities were found in this study.

As Table 12 illustrates, teacher participants were members of various types of professional learning communities of different sizes, objectives, durations, and locations. For example, Carter was a member of four different types of professional learning communities which occurred through a shared email server, at his school, and outside of his school. Bill and Diane were members of two professional learning communities, while Alice was a member of one professional learning community.

Table 12. Types of Existing Professional Learning Communities Found in Study

Description of Professional Learning Community	Objective(s) of Professional Learning Community	Teacher Participants	Size or Make-Up	Location	Duration
Math teachers reflected on classroom application of PD strategies by completing evals and posting on a shared email server for other teachers to view	To share how well a professional development strategy worked in classrooms and how it was modified during application	Carter Diane	Mathematics teachers at school	Shared email server at school	Ongoing
Staff meetings regarding school improvement and accreditation featured professional development strategies.	To provide strategies on how incorporate reading throughout the curriculum	Carter Diane	All teachers at school, presenters from the same and other schools	School	Ongoing
Math teacher and special education teacher co-teaching a math class two hours a day	To provide instruction to a regular education mathematics class with special education students	Bill Special Education Teacher	2	School	Ongoing
Math teacher and English teacher from same school regularly collaborating and sharing professional development strategies during the school day	To mentor one another by sharing concepts and professional development strategies	Carter English teacher	2	School	Ongoing
Math professional development session regarding a particular math program/curriculum implemented at school	To provide teachers from various schools and districts with professional development strategies for use in mathematics classrooms	Alice Bill	Teachers from various schools and districts	Off school site	Periodic (i.e. 3 or 5 day workshops, summer institutes)
Attendance at various mathematics teacher professional development conferences	To provide instructional strategies and concepts to mathematics teachers	Carter	Math teachers and presenters from various districts	Off school site	Periodic and Annual Conf.

Some of the teacher participants were not only members of professional learning communities which were comprised of fellow mathematics teachers, but were also members of professional learning communities with teachers representing other subject areas. For example, both Carter and Diane were members of a professional learning community facilitated through their regular school improvement and accreditation meetings with all teachers at their school. Further, the activities of this professional learning community produced the emergence of another smaller professional learning community among the mathematics teachers at Carter's and Diane's school through communications via the shared email server about evaluations of applications of professional development strategies. Additionally, Carter and Bill were in a two-member professional learning community with an English teacher and special education teacher, respectively.

A review of Table 12 also reveals that the duration of these professional learning communities varied. For example, most of the professional learning communities fostered ongoing collaborations among its members; however some professional learning communities (Alice and Bill), which consisted of a series of workshops or institutes, occurred at set times during the school year. Carter's annual participation at a particular mathematics conference from which he indicated that he always learned a strategy that he could use in his classrooms (Carter, Interview 1, p. 7), represents a type of professional learning community that will become more evident in Chapter 6. The final chapter illuminates the relationship between the major findings of this study and the scholarly framework grounding the study.

CHAPTER 6

CONCLUSION

The two previous chapters described major findings regarding the teacher participants'

professional development experiences, applications of professional development strategies in

their classrooms, and outcomes of their teacher professional development through teacher

learning, student learning, and changes in instructional practices, including an analysis of their

readiness to be members of professional learning communities and the types of existing

professional learning communities found among teacher participants. This chapter responds to

the scholarly framework presented in Chapter 2 by discussing how these findings contribute to

the scholarship on teacher professional development. In order to accomplish this task, this

chapter situates the findings with respect to the following three areas described in the scholarly

framework: 1) school and district influences on teacher professional development, 2) teacher

professional development practices, and 3) concepts and practices which have been found to be

true among members of professional learning communities.

School and District Influences on Teacher Professional Development

Recall from Chapter 2 that teacher professional development may be viewed as

contextual in nature because it is dependent upon certain features and characteristics which may

only exist within that organization (Sparks & Loucks-Horsley, 1990, p. 247). This contextual or

situational nature of teacher professional development existed in the contexts where participants

taught mathematics. For example, Bill engaged in collaboration, an important teacher action

(discussed later relative to the scholarly framework), because of a special education teacher

assigned to his classroom (Bill, Interview 3, p. 16). Additionally, as frequently noted in this

study, Diane's athletics coaching schedule often limited her opportunities to attend professional

development sessions that were specifically focused on mathematics, as well as limited her collaboration with mathematics teachers from other schools (Diane, Interview 1, p. 14-15). Further, Carter's reference that he was the person at his school who made decisions about technology use for student learning provides an example of how some schools may be more apt than others to "involve participants in decision making" (Sykes, 1999, p. 157 and Carter, Interview 1, p. 5).

Similar to Sparks-Loucks-Horsely's view that teacher professional development is contextual in nature, Sykes added that there are specific organizational, cultural, and structural factors influencing teacher professional development (Sykes, 1999, p. 170). Three organizational factors – 1) support (administrative and external) and resources, 2) time for teacher professional development, and 3) school climate - and one structural factor – opportunities for teachers to engage in professional learning, reflection, and collaboration – influenced how teacher professional development proceeded in this study. With respect to support and resources for teacher professional development, all participants indicated that the administrations at their respective schools supported teacher professional development (Alice, Interview 1, p. 5; Bill, Interview 1, p. 9; Carter, Interview 1, p. 9; and Diane, Interview 1, p. 21). In fact, Carter mentioned that although there was a lack of funds at his school for teacher professional development, his administration encouraged teachers to find professional development on their own and allowed them to "go off site a couple times a year" (Carter, Interview 1, p. 9). Similar to Carter's school having a lack of funds for teacher professional development, Bill described instances when materials and resources, such as interactive white boards, computers, and graphing calculators might not be readily available to incorporate professional development strategies in his classroom. (Bill, Interview 2, p. 4 and Bill Interview, 1, p. 6 and p. 10). Here,

having adequate funding and resources proved a critical element to professional development implementation, one also recognized in scholarship as a context standard required for effective teacher professional development (NSDC, 2001).

Continuous support from external sources also proved important for effective teacher professional development (Fullan; Guskey; Hodges; Miller, Lord & Dorney; NCRTE; NEA; Pink & Hyde cited in Hawley & Valli, 1999, p. 141). Further, the organizational context for teacher professional development is one that "…orchestrates a range of linked activities over time that combine internal work with external consultations. Such work is school and classroom centered while connecting with outside sources of expertise" (Sykes, 1999, p. 174). This could readily be seen in the teaching contexts of both Alice and Bill, where teacher professional development coaches regularly visited their classrooms, as a component of the teacher professional development, and supported the implementation of mathematics curricula adopted by their schools (Alice, Fieldwork reconnaissance and Bill, Interview 1, p. 15).

Time, another organizational factor, also influenced teacher professional development in schools and districts. Scholarship recognized that "the provision of time is one of the greatest challenges to implement effective teacher professional development" (Cambone; Corcoran; Troen & Bolles; Watts & Castle cited in Abdal-Haqq, 1996, p. 2). While acknowledging time as a challenge in implementing teacher professional development in schools and districts, scholarship advises that teachers need time and opportunities to collaborate with their peers regarding new instructional strategies and assess which strategies are more effective with students than others (Hawley & Valli, 1999; Sparks, 2001). The challenge and importance of time became evident in the teaching contexts of both Carter and Diane. For example, Carter indicated "there's not a lot of time [to share how professional development strategies worked in

teachers' classrooms]…so there has been some frustration sharing it with colleagues" (Carter, Interview 3, p. 10). Adding, "That's kind of incumbent upon the administration to carve out that time" (Carter, Interview 3, p. 7). Scholarship also agrees that administrators can positively influence the organization and culture of schools and districts where teacher professional development occurs (Deal & Peterson cited in Guskey & Sparks, 1996, p. 4; Conley & Bacharach cited in Sparks & Loucks-Horsley, 1990, p. 245).

Again, Diane's coaching schedule did not allow her adequate time to participate in mathematics professional-development opportunities, a challenge that the literature cites may be countered by "reducing teacher administrative assignments" (Sparks, 2001, p. 2), but which did not happen in Diane's case. Additionally, Diane noted, "…there's so much out there [teacher professional development]…it's really hard to find what is the most beneficial with I guess, I hate to say it, with the least amount of time…'cause you don't have a lot of time…I mean there's so much other stuff to do" (Diane, Interview 1, p. 27). In an effort to minimize the challenge of allocating time for teachers to meet and collaborate about professional development strategies, half days were set aside at Carter's and Diane's school during regular school improvement and accreditation meetings (Carter, Interview 1, p. 7), another strategy recommended by scholarship: as a way to provide more time for teacher professional development (Watts & Castle cited in Abdal-Haqq, 1996, p. 4).

With respect to school climate, the third organizational factor influencing teacher professional development, teacher participants taught mathematics in an atmosphere where experimentation in teacher professional development without penalty was encouraged (Sparks & Loucks-Horsley, 1990, p. 245). Thus, teacher participants worked in schools that invited their trying out new strategies, and participants regularly modified and adapted professional

development strategies to work in their respective classrooms. For example, Bill routinely applied new professional strategies using the graphing calculator in his classroom and Diane described her experimentation with professional development strategies as, "trial and error, and playing around with it [interactive white board]" (Diane, Interview 2, p. 8). Further, Alice described experimentations with professional development strategies, saying: "After I teach it in one way, I might see better ways to teach it next time…" (Alice, Interview 3, p. 6).

In terms of schools and districts providing opportunities for professional learning for teachers, recall that schools need to be structured in ways which provide teachers with opportunities to learn in individual and group situations, to receive and give assistance, to reflect upon learnings, and to collaborate about student learning and student performance (Hawley & Valli, 1999, p. 144; Sparks & Loucks-Horsley, 1990, p. 247). These structures were found to some extent at the school level, but were more readily seen through the contexts where the teacher participants experienced the professional development. At the school level, Carter and Diane were each asked during their professional development experience, which occurred at their school's regularly scheduled school improvement and accreditation meetings, to select a reading across the curriculum strategy from a book, to apply it in their classrooms, and then to share how the strategy worked in their classrooms with their colleagues at the school (Carter, Interview 2, p. 12; Diane, Interview 2, p. 4). With school improvement and accreditation meetings an existing structure at their school, structures in Carter and Diane's school provided teachers with opportunities to learn in individual and group situations, as well as collaborate about student learning. Such professional development sessions occurring within their school structure also provided opportunities for professional learning. Alice and Bill also experienced professional learning which included structured opportunities for teachers to either share their

classroom experiences in applying an instructional strategy with other teachers attending the professional development sessions or to present a class lesson that they would plan to eventually use to incorporate the instructional strategy (Alice, Interview 1, p. 4; Bill, Interview 1, p. 6).

Other structured opportunities for professional learning (occurring in the context of teacher professional development experiences) included group presentations by teacher participants with other attendees of professional development sessions, feedback and collaborations with other teachers on using a strategy with students, and teacher reflections. Teachers found these professional development activities integral components of the context of the teacher professional development experience. Thus, in addition to teaching contexts' influences on their teacher professional development, the teacher professional development contexts themselves proved important.

Teacher Professional Development Practices

Scholarship recognizes many practices support effective teacher professional development, and these are reflected in NSDC's standards for professional development (discussed in Chapter 2). This section discusses study findings relative to effective teacher professional development practices, by reviewing the major goals and outcomes of teacher professional development: teacher learning, student learning, and changes in teacher practices. Additionally, this section will discuss how study findings reveal important concepts and practices found important in professional learning communities.

Teacher Learning and Student Learning

Teacher participants described their learning from professional development experiences in terms of acquiring knowledge of new instructional strategies (Diane, Interview 3, p. 3 – 4; Alice, Interview 2, p. 4; Bill, Interview 3, p. 1). This aligned with what is already known about

teacher professional development in that "it helps teachers enhance their knowledge of content, so they are better able to answer students' questions, enliven lessons, and help students solve problems" (Sparks & Hirsh, 2000, p. 3). For example, teacher professional development strategies involving factoring (used by Alice and Carter) and the use of the graphing calculator (used by Bill) provided teacher participants with vehicles to help their students solve various mathematics problems. In fact, teacher participants referred to these professional development strategies as *tools* to help them accomplish various objectives and tasks with their students (Diane, Interview 2, p. 9; Alice, Interview 2, p. 3; Carter, Interview 1, p. 10; Bill, Interview 1, p. 3). Additionally, reading-in-the-content-area strategies "enliven[ed] lessons" by providing opportunities for students to make connections to prior knowledge and served as a foundation for future learning (Carter and Diane). Furthermore, Carter described the outcome of his learning (regardless of whether or not he applied professional strategies in his classes) as providing him with "insight into math and how to better think about it and make connections," also saying that the knowledge and understanding of instructional strategies "led to [his] better, deeper understanding of algebra, and cemented [his] knowledge of [mathematical] concepts" (Carter, Interview 3, p. 25). Carter's comments reflect major goals of teacher professional development to deepen the theoretical subject area of [teachers' knowledge]" (NSDC, 2001) and that teachers must have a thorough, deep, and flexible understanding of the subject matter to assist students in relating concepts to one another (Darling-Hammond, 1998, p. 6).

Teacher participants learned about these new instructional strategies through their participation and engagement in several, specific teacher professional development activities. Recall from Chapter 2 that schools and districts have been called upon to utilize professional activities of teachers as optimal opportunities to enhance teacher learning "in conjunction with

targeted work related to their students' learning" (Sykes, 1999, p. 173). Such "targeted work" was evident in the range of specific professional development activities (i.e. graphing calculator activities, y-intercept strategies, reading-in-the content area activities), as reflected in Table 5 that teacher participants engaged. These teacher professional development activities were found to align teacher learning with student learning, an aspect highlighting that the most important foci of teacher learning should be student learning and the content of student learning (Sykes, 1999, p. 176). Alignment of teacher learning with student learning was found, for example, when participants worked in groups with other teachers during a professional development session to complete various mathematics exercises and presented their findings to the group of teachers in attendance. When teacher participants returned to their classrooms, they used this strategy with their students, in the same manner in which they learned it, asking students to work in groups to complete an assignment and share their answers with the entire class through group presentations.

Changes in Teacher Practice

When teachers have professional development opportunities where they learn new instructional strategies and proceed to apply them with their students, scholarship describes three different scenarios that may occur: "[t]eachers may transform their practices over time, or they may change the innovation to fit their existing practice, or the experiment may end in disillusionment and withdrawal from further adventures" (Sykes, 1999, p. 157). The first two scenarios occurred among teacher participants who continuously modified and adapted professional development strategies into their daily instructional practices. Recall that Diane said she "adapted them [reading-in-the-content-area strategies] over time, because [she had] been doing them [for] three quarters" (Diane, Interview 2, p. 1) and Carter indicated "…every year

that I go to it [professional development conference], I get something that I've been able to roll into my class" and "I actually changed the way that I taught a certain concept because of that conference…completely changed it. I teach it a new way now" (Carter, Interview 1, p. 7). These examples exemplify scholarship's conclusion that change in teacher practices among mathematics teachers occurred when teachers were provided with "even more concrete topic-specific learning opportunities" (Cohen & Hill cited in Sykes, 1999, p. 164). Further, scholarship advises that "professional development focused on a higher-order teaching strategy result[s] in teachers' increasing their use of their strategy in the classroom" (United States Department of Education, 2000, p. 5). This was clear in Bill's continued use of graphing calculator applications that he learned from his professional development experiences.

In addition to changes in teacher participants' practices due to the integration of professional development strategies, recall that teachers regularly engaged in a range of specific actions and contexts (Table 11). As discussed in Chapter 5, when these actions and contexts are organized according to NSDC's context, process, and content standards of professional development, teachers' actions and contexts mirror professional learning community practices and concepts (a point that will become clearer as this discussion continues). In fact, an analysis of these teacher actions and contexts revealed a relatively even distribution of teacher actions and situations among the teacher participants, which spread across context, process, and content readiness for professional learning communities. This finding lends support to NSDC's assertion that "context, process, and content standards are all necessary to ensure that staff development improves student learning. If one dimension is ignored, the intended results are far less likely to be achieved" (NSDC, 2001, p. 2). Further, the listing and description of teacher actions and contexts in Table 11, organized by NSDC's context, process, and content standards of

professional development, not only provide additional information to describe how members of professional learning communities function and the practices in which they engage, but these teacher actions and contexts also provide a new concept with respect to professional learning communities: professional learning community readiness. Thus, teacher actions and contexts detailed in Chapter 5 serve as a lens to determine, describe, and articulate the type of readiness (context, process, and content) that a teacher exhibits for becoming a member of a professional learning community.

<div align="center">Professional Learning Community Concepts and Practices</div>

This research found that Astudo and colleagues' (1993) definition of a professional learning community held for the contexts where teacher participants taught. As Astudo, et al. wrote:

> Professional community of learners, in which the teachers in a school and its administrators continuously seek and share learning, and act on their learning. The goal of their actions is to enhance their effectiveness as professionals for the students' benefit. (Astudo and colleagues cited in Hord, 1997, p. 6)

Teacher participants "acted on their learning," as revealed through the listing and descriptions of their actions in contexts in Chapter 5. Additionally, all of the participants engaged in the action of modifying and adapting professional development strategies in their classrooms based on what they thought were in the best interests of their students' learning or as Astuodo's definition notes "for the students' benefit."

As professional development strategies were integrated into instructional practices, and teachers engaged in many specific actions and contexts, teacher participants also engaged in continuous reflection and evaluation of their practices with other teachers as they used

professional development strategies with their students. This highlights a major concept related to professional learning communities; professional learning communities provide a venue for teachers to freely share their professional experiences and practices with their colleagues and "[teachers] are comfortable sharing both their successes and failures" (Wignall cited in Hord, 1997, p. 23). In addition, scholars understand evaluation as a key aspect of teacher professional development and emphasize that teacher professional development must "develop [teachers'] reflective capacities" (Hawley & Valli, 1999, p. 137). As such, evaluation in this study was conducted by and among the teacher participants themselves in the form of teacher reflections, either formally during structured time in the contexts where they experienced the professional development or informally such as when Carter reflected before a class about using a certain professional development strategy (Carter, Interview 1, p. 18). Also, recall that some evaluative activities concerning the application of professional development strategies in classrooms were electronically shared among teachers at Carter and Diane's school.

Teacher participants' discussions with other teachers about the application of professional development strategies in their classrooms through the sharing of reflections about the effectiveness of the strategies with students reveal two additional concepts and practices of professional learning communities: dialogue and collaboration. Bullough and Pinnegar (2001) emphasized that "teachers and other professionals negotiate their understandings of practice through reflection and learning conversations" (Bullough & Pinnegar cited in Schuck, Aubusson, & Buchanan, 2008, p. 216). Further, Louis and Kruse (1995) used the term "reflective dialogue" to describe the discussion among teachers about their practices and student learning while identifying challenges associated with them (Louis & Kruse cited in Hord, 1997, p. 18). Such conversations and dialogue were demonstrated by teacher participants through collaborations

with teachers both from their own and from different schools. In fact, collaboration was a teacher professional development activity prevalent among all of the varieties when teacher participants rated the impact of their teacher professional activities on their understandings and perspectives of teacher professional development, content knowledge and theoretical understandings, instructional practice, and student's learning.

In addition to collaboration being recognized by scholarship as a major concept and practice associated with professional learning collaboration, this study revealed that teacher participants engaged in different forms of collaboration and had varying ideas as to what actually comprised collaboration. Recall, for example, that Bill viewed his daily work with the special education teacher assigned to his classroom as collaboration (Bill, Interview 3, p. 14); while Carter viewed one aspect of collaboration as observing other teachers model an instructional strategy during a teacher professional development session (Carter, Interview 3, p. 25). Additionally, some collaboration about the application of professional development strategies were facilitated through a shared email server at Carter's and Diane's school.

Not only is collaboration an important practice among members of professional learning communities, but scholarship advises that collaboration should be a continuous process of teachers working together to understand and improve their practice for the purpose of improved student learning and achievement, and these continuous processes should ideally be built into the regular, daily practices of the school (Dufour, 2004, p. 5 and Burnett, 2002, p. 52). Having professional learning communities built into the regular, daily practices of the school implies job embeddedness, another concept central to professional learning communities. Job embeddedness was especially seen in the interactions between Carter and another teacher at his school, which Carter described as a mentoring relationship (Carter, Interview 3, p. 11), as well as the regular,

school improvement meetings at Carter and Diane's school where they engaged in professional development activities.

As teacher participants regularly fostered collaborations about teacher professional development strategies with other teachers in their teaching contexts and through their professional development experiences, different types of professional learning communities became apparent. Not only were teacher participants found to "continuously seek and share learning, and act on their learning" as a professional community of learners is defined by Astudo and colleagues (1993); teacher participants became members of more than one professional learning community with different members at the same time. For example, Carter was a member of four professional learning communities through the shared email server, at his school, and outside of his school. In addition, the professional learning communities existing among teacher participants had specific purposes and varied in duration.

Within the professional learning communities found in this study, additional concepts and practices came to light, such as observation, when Carter indicated that he regularly observed his colleague's classroom and the nurturing of caring relationships. Carter indicated that his colleague regularly collaborated about professional development concepts and strategies and was a "good friend" (Carter, Interview 3, p. 10). Observing other teachers' classrooms and nurturing caring relationships are both practices that scholarship identifies with professional learning communities (NSDC, 2001).

The different types of professional learning communities found to exist among teacher participants in this study revealed that teacher participants regularly collaborated in different ways to reflect upon and improve their instructional practices for the improvement of student learning, the ultimate goal of professional learning communities and the hallmark of teacher

professional development.   Further, since "researchers who have studied schools where educators actually engage in professional learning community practices have consistently cited those practices as our best hope for sustained, substantive school improvement," (Dufour, 2007, p. 3); educators, particularly teachers, administrators, and professional development coordinators, could review these findings to understand and become aware of specific activities, actions, and contexts associated with successful professional learning communities, especially those teachers may be already engage or want to engage. Ultimately, it is hoped that readers who are educators might proceed to encourage, support, and foster teaching and professional development contexts that cultivate these teacher actions and practices.

Study Limitations

This study depends on a small sample of teachers, and the findings are thus necessarily limited. However, teachers from both urban and suburban schools participated, and there was little difference in findings seen across these two contexts. This suggests the centrality of teacher professional development to the practice of teaching, as well as the importance that teachers who participate in the activities place on it for their work.

Implications for Further Research

Study findings and conclusions point to three additional areas of further study: 1) collaboration, 2) school and district support, and 3) professional learning communities through electronic media. As discussed earlier, collaboration was an important activity among teacher participants, and it also described their readiness to participate in professional learning communities. It would be interesting to further understand, describe, and even compare and contrast the collaborations of teachers in TPD with teachers who are not from their own schools. As I completed this study, I began to wonder in what ways these collaborations the same and/or

different to collaborations with teachers from the same school, how such collaborations are fostered, and how supported. These topics would prove worthy subsequent research undertakings.

In terms of support for teacher professional development as an area of potential study, it would interesting to determine the forms of support that exist for professional learning communities at a school or in a school district, how effective the support proves to be, and how teachers utilize the support offered to them in a professional learning community. Additionally, since teacher participants indicated that their administrators were supportive and encouraging of their professional development, further research could focus on how administrators support professional learning communities, on administrators' roles in professional learning communities, and on the specific actions and contexts administrators regularly engaged to support professional learning communities.

Third, future studies might focus on professional learning communities sustained through electronic media. In particular, I wondered what specific actions teachers engage in while participating in "virtual" learning communities, and how these actions varied when compared to those actions and practices where teachers collaborate about professional development strategies through personal contacts.

APPENDIX A "INTERNAL REVIEW BOARD APPROVAL MEMO"

WAYNE STATE UNIVERSITY

HUMAN INVESTIGATION COMMITTEE
101 East Alexandrine Building
Detroit, Michigan 48201
Phone: (313) 577-1628
FAX: (313) 993-7122
http://hic.wayne.edu

CONCURRENCE OF EXEMPTION

To: Sibyl St. Clair
College of Education

From: Ellen Barton, Ph.D.,
Chairperson, Behavioral Institutional Review Board (B3)

Date: December 02, 2009

RE: HIC #: 11770983X

Protocol Title: Understanding a Teacher Professional Development Program Focused on High School Algebra in an Urban, Predominantly African American School District

Sponsor:

Protocol #: 0911007756

The above-referenced protocol has been reviewed and found to qualify for **Exemption** according to paragraph #2 of the Department of Health and Human Services Code of Federal Regulations [45 CFR 46.101(b)].

- Information Sheet (dated 12/2/09)

This proposal has not been evaluated for scientific merit, except to weight the risk to the human subjects in relation to the potential benefits.

- Exempt protocols do not require annual review by the IRB.
- All changes or amendments to the above-referenced protocol require review and approval by the HIC BEFORE implementation.
- Adverse Reactions/Unexpected Events (AR/UE) must be submitted on the appropriate form within the timeframe specified in the HIC Policy (http://www.hic.wayne.edu/hicpol.html).

NOTE:

1. Forms should be downloaded from the HIC website at each use.
2. Submit a Closure Form to the HIC Office upon completion of the study.

APPENDIX B "TEACHER INTERVIEW PROTOCOLS"

Teacher Interview Protocol #1

Opening:

My name is Sibyl St. Clair and I will conduct three individual interviews with eight teachers who participated in the Algebra 1 Teacher Professional Development Program. Prior to each interview, I will inform interviewees that I will take notes during the interview as well as tape-record. Also, I will emphasize that the responses will remain anonymous and that no one will hear responses except for me and my advisor. Furthermore, their real identities will not be associated with these responses and information obtained from this interview will only be utilized for the purposes of this research. In addition, I will assure the interviewee that I will destroy the tape at the end of the study. Finally, I will indicate that the purposes of the first interview are to understand:

- ▪ The organization and culture of the school and district in which teacher professional development occurs
- • Teachers' beliefs and attitudes with respect to teacher professional development
- • Activities that teachers were engaged in during the teacher professional development

Questions:

1. How long have you: a) taught high school mathematics? b) taught high school mathematics in this school district? c) taught Algebra I in this school district?

2. Tell me about your experiences teaching the Algebra 1 course. In your response, please discuss:

   a. Goals and objectives of the course
   b. Successes and challenges with respect to student learning
   - ▪ If there were any challenges, please discuss if/how they were resolved
   c. How your instruction of this course has changed or remained the same over the years

    d. To what do you attribute to this change, if any, in your instruction of this course?

3. What are your beliefs and attitudes regarding: a) teacher professional development in general? and b) mathematics teacher professional development?

4. Please describe how the Algebra 1 Teacher Professional Development Program is organized. In your response, please discuss:

    a. Goals and objectives
    b. Concepts/topics that were covered
    c. Conveners
    d. Format
    e. Scheduling and time allocation
    f. School level and central level administrative support
    g. External support
    h. Additional resources

5. Describe the activities which comprised the Algebra 1 Teacher Professional Development.

6. Is there any one particular activity that you remember most? If so, please explain and describe the activity.

7. Describe a typical Algebra 1 teacher professional development session.

8. Tell me about your experiences as a participant of the Algebra 1 Teacher Professional Development Program.

9. Discuss to what extent and how you are engaged in teacher professional development associated with the algebra course as part of your daily work?

10. Describe any teacher professional development activities associated with the algebra course that you are engaged in during the school day.

Teacher Interview Protocol #2

Opening:

I will conduct three individual interviews with eight teachers in the teacher professional development program. Prior to each interview, I will inform interviewees that I will take notes during the interview as well as tape-record. Also, I will emphasize that the responses will remain anonymous and that no one will hear responses except for me and my advisor. It will also be emphasized that the teachers' demonstration of a lesson (see below) is in not evaluative in any way, rather a method to expand and deepen the researcher's knowledge of how the teachers used what they learned in the teacher professional development for the purposes of this research. Furthermore, their real identities will not be associated with these responses and information obtained from this interview will only be utilized for the purposes of this research. In addition, I will assure the interviewee that I will destroy the tape at the end of the study. Finally, I will indicate that the purpose of the second interview is to understand how teachers in the proposed research actually use(d) what they learned from the teacher professional development in their classrooms. A whiteboard and/or easel paper will be provided for the teacher to use during this interview as well as a laptop with the software and textbook associated algebra course.

Questions:

Demonstrate a lesson that best displays how you use(d) in your classroom what you learned from the Algebra 1 teacher professional development. As you demonstrate, please discuss and describe the following:

- Objective(s) of lesson
- Concept(s) or strategy(ies) learned from the teacher professional development
- How you applied the concept(s)or strategy(ies)
- To what extent the concept(s) or strategy(ies) learned from the teacher professional development assisted you in the instruction of this lesson
- Questions that students asked during the lesson
- To what extent the concept(s) or strategy(ies) learned from the teacher professional development assisted you in responding to students' questions (alignment of teacher learning with student learning)

(During the teachers' demonstration of the lesson, the researcher will ask clarifying questions such as: "What is this?" and "What are you doing now?").

Teacher Interview Protocol #3

Opening:

I will conduct three individual interviews of eight teachers in the teacher professional development program. Prior to each interview, I will inform interviewees that I will take notes during the interview as well as tape-record. Also, I will emphasize that the responses will remain anonymous and that no one will hear responses except for me and my advisor. Furthermore, their real identities will not be associated with these responses and information obtained from this interview will only be utilized for the purposes of this research. In addition, I will assure the interviewee that I will destroy the tape at the end of the study. Finally, I will indicate that the purpose of the third interview is for teachers to reflect on their learning both before and after their participation in the teacher professional development.

Questions:

1. Compare and contrast your understanding of the topics covered in the teacher professional development <u>before</u> your participation in the professional development sessions with your understanding of the topics covered <u>after</u> your participation. In your discussion, reflect upon your learning <u>before</u> and <u>after</u> participation in the teacher professional development with respect to:

    a. Content knowledge and theoretical understandings
    b. Knowledge of instructional strategies for algebra course
    c. Application of instructional strategies in your classroom
    d. Provide examples of the above if applicable

2. Compare and contrast your: beliefs and attitudes regarding a) general teacher professional development and b) mathematics teacher professional development both <u>before</u> and <u>after</u> the Algebra 1 teacher professional development.

3. Describe any impact(s) that you think the Algebra 1 teacher professional development had on your beliefs and attitudes regarding a) general teacher professional development and b) mathematics teacher professional development.

4. Describe any impact(s) that the Algebra I Teacher Professional Development had on your teacher practice. In your description, please discuss and provide examples of:

   a. Strategies and approaches that you applied which were learned from the Algebra 1 teacher professional development
   b. Successes and challenges encountered during application. If challenges were encountered during application, please explain the extent to which and how they were resolved.
   c. The extent to which these successes, challenges, and resolutions were shared with your colleagues who also participated in the Algebra I Teacher Professional Development
   d. If applicable, did the above sharing referenced in item c with your colleagues impact your a) learning and b) instructional practice(s) in any way? Please explain your answer.

5. Discuss your students' learning <u>before</u> and <u>after</u> your participation in the Algebra 1 Teacher Professional Development. In your discussion, please describe and provide examples of:
   a. Areas and content strands that your students' learning changed and/or improved
   b. To what, specifically, do you attribute this change(s), if any, in student learning?
   c. The extent to which your learning from the Algebra I Teacher Professional Development aligns with your students' learning. Provide an example.

6. Reflecting on your learning both <u>before</u> and <u>after</u> participation in the teacher professional development **and** utilizing a list of activities that have been identified by your colleagues during the first interview as components of the Algebra 1 Teacher Professional Development, sort these activities from the greatest to the least impact on your:

   a. Beliefs and attitudes regarding general teacher professional development and mathematics teacher professional development
   b. Content knowledge and theoretical understandings
   c. Teacher/instructional practice
   d. Student Learning
   e. For items a, b, c, and d please explain why you sorted the activities in a particular manner.

Note: The researcher will provide the interviewee with the names of the activities that were identified by respondents during the first interviews on separate index cards for sorting.

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ABSTRACT

UNDERSTANDING TEACHER PROFESSIONAL DEVELOPMENT FOR URBAN AND SUBURBAN HIGH SCHOOL MATHEMATICS TEACHERS

by

SIBYL YVETTE ST. CLAIR

December 2011

Advisor: Karen L. Tonso

Major: Educational Evaluation and Research

Degree: Doctor of Philosophy

This is a quasi-ethnographic (qualitative) interview examination of understanding teacher professional development for urban and suburban high school mathematics teachers. Since teacher professional development has been found to be critical in improving student learning such as mathematics achievement, and teacher professional development is recommended by the scholarship as a strategic approach to improve teacher quality through the improvement of teacher practice, the purpose of this research was to study the professional development experiences of four high school mathematics teachers. Two of the teacher participants taught in urban, public school districts and two taught in a suburban, parochial school.

Each teacher participant was interviewed three times to understand and describe how teacher professional development proceeded in this study and how teacher participants applied what their learned from their teacher professional development in their classrooms. Cyclical data analysis strategies were used to describe the teacher participants' professional development experiences. A discussion of findings includes descriptions of the outcomes of the teacher participants' professional development experiences with respect to their learning, changes in teacher practice, and students' learning. Additionally, concepts and practices associated with

professional learning communities were found to exist in this study and among the teacher participants.

AUTOBIOGRAPHICAL STATEMENT

It is with great honor and privilege that I complete this dissertation as it represents a culmination of my education and career choices. Reflecting as far back as an undergraduate and graduate student at the University of Michigan-Ann Arbor, I was always interested in teacher professional development. I can even recall my father, a mathematician, accompanying me to my very first national conference for teachers where I noticed the excitement and magic of new knowledge in the air.

With over 22 years of experience as a former high school mathematics teacher, university instructor of mathematics, administrator in the area of Research and Evaluation, and doctoral student at Wayne State University, my interests in teacher professional development began to shift to researching and understanding the characteristics of effective teacher professional development, professional learning communities, and their impact on teacher learning, teacher practice, and student learning. Using qualitative research methods such as those incorporated in this dissertation provided me with a vehicle to understand and describe such topics.

Throughout my professional career, I have shared my learning about teacher professional development through presentations at various national and regional conferences. Additionally, I wrote an article with two university professors (one of whom is my sister) and presented findings from this study at a national conference for teachers. It is my intention to continue such efforts and seek additional knowledge as it relates to teacher professional development and professional learning communities.