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Perspectives on Professional Learning: A Study of the Beliefs and Attitudes of Mathematics Teachers in High Performing Schools

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Perspectives on Professional Learning: A Study of the Beliefs and Attitudes of Mathematics Teachers in High Performing Schools

By

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DEDICATION

For my Lord and Savior, Jesus Christ, who fills my heart with peace and joy, gives my life purpose, and covers me in grace.

> "*And we know that in all things God works for the good of those who love him, who have been called according to his purpose.*"
> Romans 8:24

For my husband and number one fan, Don, who prayed with me, encouraged me, and never gave up on me. Your love inspires me. This is also for my supportive parents, Brenda and Robert Parker, who were my very first teachers. You taught me to laugh, love, and dream.

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ABSTRACT

Perspectives on Professional Learning: A Study of the Beliefs and Attitudes of Mathematics Teachers in High Performing Schools

by

Rebecca Leigh Gammill

How do mathematics teachers in high performing schools perceive professional learning? Although mathematics teachers often find themselves in a variety of professional learning opportunities offered by their schools or school systems, research has narrowly focused on mathematics teachers' behaviors, feedback, or professional learning outcomes within specific contexts. The present study explored mathematics teachers' beliefs and attitudes toward professional learning through a multi-site case study. The researcher selected seven mathematics teachers from two high performing high school settings and captured their perspectives of professional learning through photographs that were later discussed during Photo Elicitation Interviews. The researcher also elicited participants' reflections of professional learning though Professional Learning Journals and postings on a Professional Learning Discussion Board. Participants' attitudes towards professional learning and positions of intellectual development were explored for common themes throughout the study. The researcher presented Professional Learning Profiles for each participant that detailed the participant's unique views of the following: (a) perspectives of teaching and learning

mathematics, (b) career goals and professional learning goals, (c) processes by which they learn to teach mathematics, and (d) positive and negative professional learning experiences. Commonalities among the participants' learning processes were connected to a Professional Learning Sequence, and themes of relevance, professional learning contexts, participants' valuation of time, and professional learning resources were also discussed. The findings suggest that teachers' interactions with others throughout the professional learning process are influenced by their intellectual development stage and their philosophies of teaching mathematics. Additionally, professional learning structures that frame how, when, and where mathematics teachers learn substantially contributed to how teachers collaborated with one another. Further implications for research and practice are also discussed.

KEY WORDS: professional learning, beliefs, secondary mathematics, high performing schools, Professional Learning Profile, Professional Learning Sequence

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CHAPTER 1: INTRODUCTION AND DESCRIPTION OF THE PROBLEM

Introduction

Currently, policies stemming from the No Child Left Behind (NCLB) legislation (2002) have created a greater impetus for educational researchers to investigate the effects of high-stakes testing and teacher accountability. Educational research related to professional learning or high-stakes testing (Bainbridge & Lasley, 2002; Darling-Hammond, 2010; Jones, 2004; Hodgkinson, 2002) points to low-performing schools and provides explanations for the growing academic achievement differences between low-performing schools and high performing schools.

Classroom teachers have a direct and large impact on student achievement (Katzenmeyer & Moller, 2008; Leithwood, Day, Sammons, Harris, & Hopkins, 2006; Sergiovanni, 2005; Sparks & Hirsh, 2000**)**. All students should have the opportunity to learn with well-trained and experienced teachers who are knowledgeable in both their content areas and the craft of teaching (Darling-Hammond 2010, Starratt, 2003). The need for quality teachers who have both professional knowledge and knowledge of student learning is an ongoing issue in difficult-to-staff schools (Darling-Hammond & Sykes, 2003). Furthermore, students of highly qualified teachers learn more than students taught by teachers who are ill-prepared based on (teacher) educational background (Darling-Hammond, 2003; Eaker & Keating, 2009; Sparks, 2002; Sparks & Hirsch, 2000). Highly qualified teachers are needed in all schools—low, average, and high performing schools; however, due to the lack of research within high performing schools

during the climate of NCLB and high-stakes testing, there is still a lack of study regarding the professional needs, perceptions, and behaviors of teachers who work in high performing schools that are *not* the target of educational reform because they have satisfactory student performance on high-stakes tests.

High Performing Schools

The expression *high performing schools* implies multiple meanings if not explicitly defined. One inevitably asks the question, high performing *in what way*? In one study, Miles and Darling-Hammond (1998) investigated how instructional materials were allocated in high performing schools. Using several criteria, they categorized schools as high performing schools if they were positively involved in reform efforts, served diverse populations, and demonstrated "evidence of strong and improving student performance" (p. 12). Wolf, Borko, Elliott, and McIver (2000) focused on exemplary schools with diverse student populations that were also successful in the atmosphere of educational reform. Wolf, et al. (2000) vaguely described these schools as those in which "good things were happening" (p. 12) and they initially sought recommendations from center directors and administrators to identify such schools. Later, the researchers visited the sites to conduct observations and teacher interviews. Wolf, et al. (2000) specifically avoided schools wherein the schools' success would be expected, such as those located in high socioeconomic (SES) areas and/or those with technological resources provided for teachers. Thus, in both of these studies, successes within schools with diverse populations of low socio-economic status were extraordinary, surprising, and an anomaly. Both of these studies also illustrated that researchers vary in how they dynamically define and identify high performing schools. Moreover, the commonalities between these two

studies also implies that less diverse, more affluent schools are generally expected to be high performing schools when compared to more diverse schools, and thus are less interesting contexts for research.

Even among the limited number of studies that have taken place within high performing schools (Miles & Darling-Hammond, 1998; Wolf et al., 2000), few, if any, focused on teachers' perspectives in such schools. Because much of the literature related to professional learning describes or quantifies how formal programs improve student achievement, contexts in which students already achieve academic success were left out of the picture. Is it possible that schools could be described as high performing and still have room for the professional learning of their staff? If student standardized test scores were already high, how do teachers evaluate professional learning experiences as effective?

Although a plethora of research is available on the effectiveness of various professional learning programs or professional learning strategies, the evidence of effectiveness is often based on quantitative data such as student test scores, pre- and post-tests, and teacher feedback about the professional learning through the use of surveys. Often professional learning programs are evaluated for effectiveness using quantitative means (Borko & Cadwell, 1982; Hill & Ball, 2004), but rarely do the focus of the research shift to the teachers' perspectives on professional learning particularly of teachers in high performing schools. This limited literature base becomes increasingly sparse as the focus narrows to secondary mathematics teachers in high performing schools.

Among the research related to professional learning, authors have examined the effects of professional learning *on* the content knowledge or pedagogical knowledge of teachers, or have attempted to link the professional learning of teachers to student achievement. Shifting the focus of the research from professional learning *on* teachers to teachers' beliefs *about* professional learning, this study aims to add to the larger body of knowledge on professional learning within new contexts, using different perspectives, to examine how teacher beliefs sway teachers toward or away from seeking out and engaging in professional learning.

Because the purpose of this study is to explore the *meaning* behind mathematics teachers' perceptions and behaviors toward professional learning, I employed qualitative methodologies to collect descriptive and contextual data (Creswell, 1998; Merriam, 2009). Utilizing a naturalistic lens (Creswell, 1998; Merriam, 2009; Wiersma & Jurs, 2009), I critically analyzed data using interpretive methods. My literature review and theoretical frameworks have all informed the development of the research questions, interview protocol, and data analysis procedures. Following case-study methodology guidelines (Merriam, 2009; Stake, 1995; Yin, 2009), I collected data that allowed me to produce rich descriptions in order to better understand mathematics teachers' conceptions toward professional learning. My small participant sample was purposefully chosen to maximize the possibility of varied teacher perspectives, including teachers with a wide range of years of teaching experience and varied mathematical philosophies. Different variations within the data were then teased out during the analysis process as the iterative data collection process allowed me to analyze and gather data simultaneously. I acknowledged that I had reached a point of data saturation when the same themes from

multiple sources continued to emerge (Creswell, 1998; Lincoln & Guba, 1985; Corbin & Strauss, 2008).

Rationale

I chose a qualitative methodology as the approach for my study because I was interested in how teachers perceive professional learning opportunities and how they behave regarding professional learning. The intent of my research can only be answered through the explanations and the actions of my participants—not through numbers or quantitative data analysis. Although quantitative paradigms would position me to be more objective—allowing me to assert a hypothesis and test that hypothesis—my research questions lent themselves to qualitative inquiry. The purpose of this study was to explore how and why teachers perceive professional learning and to what extent those perceptions influence their subsequent behaviors regarding to professional learning.

Because I wanted to explore the participants' beliefs toward professional learning through their voices and from their perspectives, I chose qualitative methodologies to study this phenomenon and allowed findings to emerge from the data (Lunenberg & Irby, 2008; Merriam, 2009). I do not intend to impose a professional learning strategy on my participants to see how they respond, nor do I aim to help them transform their practices (Creswell, 2009; Lunenberg & Irby, 2009). This study captured the participants' perspectives where they were, within their natural contexts of teaching in high performing schools during the NCLB climate through qualitative methodologies outlined by Creswell (2009), Merriam (2009), and Stake (1995). Generalizability to a larger population is not required for qualitative research, though the findings may be meaningful in a variety of contexts (Merriam, 2009; Stake 1995). A smaller population

size allowed me to gather the rich data required to explore the research questions. I needed to answer my "how" and "why" questions through the perspectives of my participants. Moreover, I hoped to make sense of participants' beliefs about professional learning through the voices, conceptions, and behaviors of my participants (Creswell, 1998; Merriam, 2009; Yin, 2009). Thus, the qualitative paradigm, as viewed through an interpretivist lens, was the most appropriate fit among the research perspectives available to conduct this study.

Purpose

The purpose of the study was to explore the attitudes and behaviors of mathematics teachers toward professional learning in high performing secondary schools. Through the study, I intended to add to the body to the literature in which only a few studies investigate the views and experiences of the secondary mathematics teachers in high performing schools with respect to professional learning. Strategies of inquiry through a dual-site case study design (Creswell, 2009; Merriam, 2009; Stake, 1995) were employed during the iterative data collection process, analysis, and research process. It is important to clarify what the researcher means by the terms (Creswell, 2009) *professional development* and *professional learning*. The term *professional learning* includes both formal and informal processes of professional development imposed upon or individually sought by the participants for the purposes of improving their content knowledge, instructional practices, or to better understand student learning. A review of the literature highlights how researchers (Easton, 2008; Drago-Severson, 2007; Sparks, 2002) have reported to sharp differences between professional learning and professional development; the present study also seeks to define these concepts from each

participant's perspective. As the participants' definitions emerged through data analysis, a more detailed definition of professional learning led to a broadened, deepened, and narrowed one which will be compared to and contrasted with definitions provided by professional learning literature.

Significance

When using a qualitative methodology, there is no working hypothesis from which to make predictions of the findings of a study (Lunenburg & Irby, 2008; Merriam, 2009). However, given that there is little literature related to professional learning in high performing schools, a qualitative study of this nature (Creswell, 2009; Merriam, 2009) could illuminate ways to promote meaningful professional learning experiences for mathematics teachers in high performing schools so that they will value the experience, reflect upon, and implement the strategies in their classrooms in an effort to improve student achievement. Therefore, due to the lack of literature in this field, this particular study hopes to contribute to this body of knowledge as well as provide implications for professional learning within high performing schools.

Research Questions

Although the central question captures the overarching purpose of the study, the additional research questions guided the dissertation to narrow my focus along the sequential process of growth that could occur for teachers (Lunenburg & Irby, 2008; Merriam, 2009). Although I purposefully did not assume that my participants actively pursued professional learning, the open-ended questions allowed for an interpretivist lens to be applied to the various responses from these participants. My central question was developed to act as an umbrella for the sub-questions. My central research question was:

What are the attitudes and behaviors of mathematics teachers in high-performing schools toward professional learning? The subsequent guiding research questions were as follows:

1) If a mathematics teacher in a high performing school pursues professional learning, why do they pursue professional learning?
2) If a mathematics teacher in a high performing school pursues professional learning, how do they pursue it and within what contexts do they pursue professional learning?
3) If a mathematics teacher in a high performing school has been exposed to professional learning, what influences him or her to use or not use the strategies to which they were exposed?
4) If a mathematics teacher in a high performing school implements the strategies presented during some form of professional learning, how does he or she assess whether the strategy was successful?
5) How do mathematics teachers' beliefs influence their attitudes toward professional learning?

Given the review of the literature related to the goals and structures of professional learning, a few critical and unifying components underscore the need for this study. First, although much literature is related to designing and evaluating successful professional learning programs within a variety of educational contexts, there is only one exception (Gabriel, Pereira, & Allington, 2011) that focuses on the educator's perspectives on professional learning. In fact, most of the literature on professional learning focuses on articulating the effectiveness of the professional learning programs in

terms of fostering teacher change (Borko, 2004; Lambert, Wallach, & Ramsey, 2007; Sparks & Hirsch, 2000; Zepeda, 2008), developing program structures (Guskey, 2002), or evaluating professional learning as it links to student achievement (Guskey, 2002).

Although this literature offers valuable insight into program goals or effectiveness, the focus on the literature is still conveyed from the perspective of the researcher, the program evaluator, or even the administrators. What the literature fails to do is tell the story of professional learning experiences through the eyes of the teachers themselves, not for the purposes of evaluating the effectiveness of a program or to link these perspectives to student achievement, but to shed light on how teachers desire and evaluate learning experiences within the personal contexts of their professional lives. On the topic of professional learning, teacher voices seem to be marginalized, despite the fact that their perspectives could illuminate how educators define, value, and use professional learning experiences within particular school contexts. Literature that focuses on teachers' perspectives of professional learning is sparse, further illustrating that teacher voices are left out of the conversation on professional learning in general. Contexts for professional learning rarely include perspectives of those who teach high performing students. Because the literature dedicated to professional learning in high performing schools is sparse, a study that investigates the unique perspectives on professional learning held by these teachers offers a new avenue of exploration in the field of professional learning.

The implications of this study may provide insight on how this particular teaching-force sub-group, when availed of professional learning, do or do not want to change their practices on their own accord. The study may also reinforce or contradict the

current literature on teacher change within educational contexts in which change is not administratively imposed on teachers. The study also illuminated how educators engaged in or resisted meaningful professional learning experiences if the political pressures of "teaching to the test" were removed (Darling-Hammond, 2004).

I investigated participants' professional learning experiences by prompting reflection on previous learning experiences. Therefore, I considered theoretical frameworks emphasizing reflection and the nature of knowledge, how it is held and shared, and how it can be developed within professional learning settings. Thoughts about professional learning can only be garnered from interpretations of experiences, including whether and why professional learning is needed, and participants' interpretations of how they assessed the success of their professional learning . I gained additional insight about the participants and how they situated themselves in their classrooms and within categories of professional learning from reflective journals and conversations about professional learning-related articles concerning mathematical knowledge for teaching or teaching in high performing schools. Photographs provided additional information about how the participants perceived themselves in their classrooms, and how they hoped to perceive themselves in the future with or without professional learning. Among others, I explored questions such as: in what ways did the participants view professional learning as a means to meeting their professional goals, did participants naturally gravitate toward wanting to learn about how to teach, or to what extent did they wish to connect who they are within their field to promoting student learning, such as in the goals of Dufour's (2004) Professional Learning Communities (2004).

CHAPTER 2: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The following review of literature is intended to provide a synopsis of the goals and structures of professional learning within different contexts. Then the focus will narrow to discuss the literature of professional learning within the specific context of mathematics education. A "broad-brush" approach to the professional learning literature highlights many topics, including professional learning communities, teacher anonymity, professional learning effectiveness, and teacher change. In an effort to provide a relevant overview of professional development as it relates to the present study, this literature review will address general professional development characteristics, professional learning for groups and the teacher, and specifically professional development of mathematics teachers.

A Review of the Literature

Professional Development

In recent years, educational reform movements influenced by political initiatives have proposed that every student should have the opportunity to learn from highly qualified teachers (Starratt, 2003). The NCLB Act (2002) legislation requires each individual state to provide "high quality" professional learning opportunities for its teaching force. However, the definition of "high quality" professional learning is neither defined nor explained within the document (Borko, 2004), leaving much of the professional learning interpretation to state and local school districts.

Professionalism overview. Professional developers who work with schools and school districts to guide and offer professional learning experiences for teachers influence the goals, structures, and evaluation methods used throughout the process. Therefore, the professional developers' stance about professional learning sets the tone for various aspects of the professional learning process. Although the categorization of professionalism will be discussed to a greater extent within the theoretical framework, the inclusion of the categorization of professionalism will provide a clear framework by which to discuss professional learning structures. An overview of the categories provides a clear perspective for the organization and framing of the professional learning literature within this review. These categorizations will provide a perspective of how program organizers define professional development or professional learning.

Hargreaves and Goodson (1996) proposed five categorizations of professionalism: *classical professionalism, flexible professionalism, practical professionalism, extended professionalism*, and *complex professionalism*. A *classical professionalism* perspective proposes that teachers should have specialized research-based knowledge of both what they teach and how they teach. *Flexible professionalism* suggests models for professional learning that should be situated in communities of practice. *Practical* views of professionalism reflect a private, experiential, interpretive approach to development in wherein teachers construct their knowledge through reflection. *Extended* and *complex professionalism* perspectives only expand a teacher's role so that he or she may observe a broader perspective regarding how he or she "fits" into and works within a school, community, or self-evaluation procedure (Hargreaves & Goodson, 1996). Each of these classifications of professionalism set the tone for the different professional learning

initiatives found within educational contexts. Although the five categories of professionalism will be discussed in greater detail within the theoretical framework, applications of all of these classifications of professionalism to professional learning experiences lead to community-centered or teacher-centered models in which different types of leadership strategies are often employed.

In the field, a discussion has ensued regarding *product* versus *process* view (Drago-Severson, 2007; Easton, 2008) of development. Easton (2008) suggested professional learning was not enough; teachers need to learn to be knowledgeable in order to change. Easton (2008) asserted, "They must become learners, and they must be *self*-developing" (p. 756). Although a distinction between these terms is important, the phrase "professional development" is still used quite broadly by some who use development either as a noun, as an end product of learning, or as an active verb, for the process of learning (Easton, 2008; Sparks, 2002).

These different perspectives alone have great implications for how a professional learning program is designed, implemented, and evaluated (Easton, 2008; Guskey, 2000). Professional learning distinguishes itself in the literature as a process by which a teacher will grow. This process is evaluated by qualitative measures, such as observations and interviews, through which teachers exhibit improved content or pedagogical behaviors in the classroom (Easton, 2008). Conversely, professional development implies a metaphorical "finished product" that teachers would ideally become. This is generally assessed through quantitative measures in order to gauge the extent to which a teacher has approached the ideal and intended fixed goal of the professional learning strategy.

Teacher change and program effectiveness. Although the semantic differences between professional development and professional learning have been fleshed out to a great extent, much of the literature still uses these terms interchangeably. Professional learning programs are purposeful and use strategic efforts to change teacher practices, attitudes, or beliefs (Guskey, 2002). High-quality professional learning helps teachers embrace change, increase content knowledge and pedagogical skills, and improve student learning (Desimone, Smith, & Ueno, 2006). Professional learning opportunities should include a clear purpose, accountability for implementation, a shared language, hands-on activities, follow-up assistance, and strong leadership (Blackburn & Williamson, 2010).

Effective professional learning immerses teachers in subject matter and teaching methods, focuses on curriculum and standards-based goals, provides ongoing, cumulative, and challenging support, and is linked to the practice of teaching (Sparks & Hirsch, 2000). Some guidelines for developing effective professional learning include clear program goals related to student achievement, high accountability for educational leaders and teachers, connecting school improvement plans to the program goals, providing opportunities for professional learning during teachers' daily schedules, and equipping teachers with classroom-assessment and action-research skills (Sparks & Hirsh, 2000).

Professional learning programs that fail to acknowledge the adult learning needs of teachers are less likely to be effective. Guskey (2002) asserted that professional learning programs are ineffective in changing teacher practices when they (1) fail to acknowledge what motivates teachers to change; and (2) when program designers do not understand the change process.

Teachers pursue professional learning to improve their content knowledge, instructional practices, and their effectiveness with students. When they fail to make the connections between the strategies presented in professional learning "one-stop shops" and their daily practice, they can be discouraged and dissuaded from changing their practice (Darling-Hammond & Richardson, 2009). This change process is actually accelerated when teachers see the products of their efforts through changes in their students' learning outcomes. This gradual evolution is difficult for teachers, and they therefore need regular feedback, expectations, and ongoing support to facilitate the process (Guskey, 2002). According to Guskey (2002), teachers are likely to change their beliefs and attitudes only after they have tried a strategy that produces a student outcome that is desired. This evidence reinforces the change process and causes teachers to gain momentum in their enthusiasm for learning. Additionally, as adult learners, these teachers experience transformative learning when professional learning opportunities foster and nurture professional relationships, and when the instruction is challenging, practical, and rigorous (Lambert et al., 2007; Sparks & Hirsch, 2000; Zepeda, 2008).

Professional learning programs may also fail when the program designers are not well-versed in adult learning theory (Lawler & King, 2003; Zepeda, 2008). When studying teachers of adult learners, Lawler and King (2003) found that adult learners need to feel understood and respected. The learning process should include critical reflection and give justification of the application of strategies into their practices. This approach to professional learning puts a great emphasis on how each participant learns, and highlights that adult learning should utilize technology to foster communication, help learners explore worldviews, and have focused professional learning in which

participants can develop their inner, independent “voices” (King & Lawler, 2003; Zepeda, 2008).

Roles for professional learning. Professional learning opportunities can be collaboratively focused through professional learning communities (Dufour, 2004), mentoring relationships (Feimen-Nemser, 2003) or collaborative pairings (Cochran-Smith & Lytle, 1993). However, professional learning can also be designed to help individual teachers develop their practice from the inside out through constructivist, reflective, and situated means. For example, through professional learning communities, teachers construct meaning about professional learning topics through interactions with their peers. Professional learning opportunities may also provide resources or experiences in which the teacher reflects upon how, when, and if they should embed newly-learned concepts into their practice. Finally, Borko (2004) discussed how a situated perspective of learning suggests that learning not only occurs through the construction of knowledge but also within the contexts of which the knowledge is applied. Therefore, teachers learn and experiment within several contexts—their classrooms, informal conversations in school hallways, school communities, and within more formal professional learning environments.

Professional learning communities. What is a professional learning community? Professional learning communities are defined through the literal definitions of the words (Hord & Hirsh, 2009). By design, they bring together responsible professionals who have a commitment to their own learning. They want to learn in order to advance their skills or knowledge, and they form a community to interact, share, and construct meanings related to their chosen topics. Within these communities, teachers interact as collaborative

workers and professional learners (Hirsh & Hord, 2008). The focus on the community is to prioritize what student-centered practices can be used to purposefully target whichever students are not learning (Lambert, 2003). Learning communities prioritize student learning, examine curriculum and student work samples, identify school issues that affect student achievement, and think about and implement improved teaching strategies (Dufour, 2004; Lambert, 2003).

The fusion of collaboration with the intense focus to improve student achievement shifts the focus of professional learning from teacher learning for improved practice to teacher learning in order to promote student learning (Dufour, 2004; Lambert, 2003). By identifying who is not learning and what they are not learning, the priorities of the educators shift from teaching the masses to individualized instruction, and the teacher role shifts from transmitting knowledge to teacher coaching in the classroom (Dufour, 2004).

Hirsh and Hord (2008) described how, prior to the 1980s, teachers worked in isolation and were responsible for their own learning. When teachers later formed teams in order to talk about workplace conditions and morale, some of the barriers that used to isolate teachers as professionals began to come down. Eventually, these relationships evolved into collaborative arrangements in which teachers would work together toward loosely defined goals. However, when the professional learning among these collaborative cultures became more intentional, the educators themselves began to move into “learner” roles. This significant transference prompted educators to shift their focus from learning how to teach, to learning what the students had to learn in order to be more successful. Finally, educators became learning professionals when they began to research

for themselves what actually drives student learning in order to apply these strategies to their own classrooms (Hirsh & Hord, 2008). Additionally, professional learning communities provide structures in that the leadership within each community is distributed and the common goal of the group is to increase student achievement (Dufour, 2004; Lambert, 2003).

Teacher autonomy. In a sense, collaboration, a pillar of the professional learning community, is a prerequisite of professionalism. Dufour (2011) claimed professionalism does not equate to autonomy. He remarked, "I simply cannot find a dictionary that defines a professional as someone who can do whatever he or she pleases" (p. 58). In fact, he asserted that collaboration should be a mandated and accepted part of the education profession, just as it is for engineers, doctors, and construction managers. When collaboration is mandated, teachers can no longer shut the door to their classrooms and continue to work independently. Professional learning communities make the education of teachers more student-outcome driven, purposefully collaborative, and professionally public (Dufour, 2004).

The distributed perspective of leadership (or *distributed leadership*) lends itself to different views of professional learning communities. Spillane (2006) described the distributed perspective of leadership as practices that are situated through the interactions of the school leaders, school followers, and their situation or context through the use of tools and routines. Applying this perspective to professional learning, Zepeda (2008) stated that professional learning communities, as an application of *distributed leadership*, focus on the development of teachers, the improvement of student-learning outcomes, *embed* autonomy, and model life-long learning. Richardson (2003) brought these

conflicting ideas of autonomy to light by pointing out that well-documented research about the characteristics of professional learning has been completely ignored. He argued that teachers—and teachers in the United States in particular—have a sense of individualism that influences them to see only “my” classroom, “my” students, or “my” uniqueness. This sense of individuality promotes teacher isolation and hinders the development of professional learning communities due to the fact that the professional learning goals rest firmly on the collective beliefs of the community. These beliefs ultimately drive the goals for the organization to improve or change (Richardson, 2003).

Another perspective on teacher autonomy and professional learning is used outside of the context of professional learning communities. Engaged autonomy occurs in contexts in which educational leaders allow teachers some freedom to experiment with different instructional strategies within their classrooms (Gabriel et al., 2011). Although teachers are not left completely to their own devices, the administrators’ support and respect allow teachers to have the confidence to take risks in their classrooms and to try new things.

Low-support scenarios may also produce teachers who “tinker” in their classrooms—not due to the permission of their administrators, but in light of the absence of those administrators. Gabriel et al. (2011) advocated teacher autonomy as important when it is engaged within its educational community. This level of freedom allows teachers to look at their practice in a more reflective way. The researchers describe one teacher who pointed out that she changed her focus from “teacher learning” to “student learning.” Through that lens, she shifted her focus from her presentation of the content to how well her students grasped that content. Before making this change, she would

present content and accept that students either understood it or did not understand it. When she changed her focus, however, she worked harder to individualize the lessons in light of her students' collective needs. The guiding question that drove her practice was, "What do I need to do to get them where I want them to go?" (Gabriel et al., 2011).

Despite these vastly different views on teacher autonomy, the professional learning research does point out that many teachers are beginning to (or should) think about their learning with respect to the needs of their students. For that purpose, program developers have more reason than ever to help contextualize the learning process for teachers, recognizing their adult learning needs and their resistance to change, in order to truly engage them within the learning process. This constant tension between teacher autonomy cloaked in professional freedoms and teacher professionalism connected to collaborative obligations produces a professional learning spectrum of options that vary between individual learning goals and collective goals. With complete autonomy, teachers could isolate and disconnect themselves from the learning community in which they teach; however, within a learning community, teacher responsibilities can expand outside of the classroom, and district teachers can be separated extensively from their roles as educators. Hargreaves and Goodson (1996) noted both of these drawbacks within the practical and the expanded views of professionalism, respectively. For that reason, research (and the resulting literature) on professional learning continues to vary along this spectrum between individualism and collectivism, and so the goals, implementation, and program evaluation also vary in tandem as these lenses for professional learning continually change.

Evaluating professional learning. When schools or school systems engage in educational reform, multiple initiatives occur simultaneously, which can make it difficult to evaluate the effects of just one of the programs at a time; therefore, Guskey (2002) suggested the following guidelines for evaluating professional learning programs. The first level assesses whether the basic human needs of the participants have been met. This can usually be done through a simple survey. However, in Level 2, the program designer must measure what the participants learned with respect to the learning goals. This knowledge may be more difficult to assess. Depending on the program goals, this could be done through pre- and post-tests, classroom observations, and/or interviews. The third level assesses organizational support and change. On this level, the program should be evaluated on whether the goals of the program parallel the learning goals of the communities it serves. In Level 4, program developers need to investigate how completely the participants are actually using and implementing the new knowledge or skill within their classrooms. In the final stage, the program evaluators assess the extent to which the professional learning program affected the student learning within the community.

It is extraordinarily difficult to assess the connection between only one program and student achievement, partly because when a system undergoes educational reform, there are often multiple initiatives going on simultaneously. Although it is impossible to establish that a particular professional learning program directly caused observed changes in student achievement, student data, work samples, and school data can be collected to support such claims. Guskey (2002) also mentioned that working backward along these lines is a useful strategy for program development. In a sense, this backwards design puts

the “big picture” of student learning outcomes first, and then continues to narrow the focus via considering how (by which measures and strategies) learning goals will be addressed.

In a sense, these techniques can be applied to professional learning opportunities both within collaborative communities and in situations where teachers work within their own classrooms through inquiry measures (Cochran-Smith, 2011). Whether on a grade scale with an entire organization or with a single teacher in a classroom, the effectiveness of the program usually depends on whether or not the technique or knowledge improved student achievement. To that end, considering student samples and gathering school data could be used from both a macro and micro perspective of teaching. Although Guskey’s model (2002) is written as if it were to be applied to a formal program, Kennedy (2006) pointed out that teachers should have more time to reflect upon teaching and analyze the smallest details of their practice. Therefore, evidence of student learning could be used on a large scale, quantitatively, to target marginalized students who struggle within a community. The reflective teacher (King & Kitchener, 1994; Schön, 1983) could also collect qualitative data to produce a more detailed picture of how the strategies that he or she is currently experimenting are addressing student learning outcomes.

Professional learning in high performing schools. Existing literature of professional learning in high performing schools, although sparse, provides a snapshot of the flexible views that contribute to a framework underpinned by collaboration and learning communities. Shannon and Bylsma (2004) articulated nine characteristics of high performing schools, including professional learning. They indicated that approaches for professional learning in high performing schools include mentoring and peer support,

teacher inquiry through action research, lesson study, walk-throughs, professional learning communities, and program- (or content-) specific professional learning. All of these structures for professional learning make the learning process collaborative, reflective, and public. Teachers are brought out from the isolation of their classrooms to investigate their curriculum, their practices, and student engagement by working with other professionals within their learning communities. Although some of these techniques, such as lesson study, mentoring, and peer coaching, are considered more informal, other strategies for professional learning—such as action research or program-specific professional learning—require more funding from school districts and a greater degree of teacher leadership and involvement.

One other context for professional learning in successful schools was found by examining the very nature of successful school districts. Supporting the connection between high performing schools and professional learning communities, Many and King (2008) found that successful school districts attained and sustained their status through the implementation of top-down models of professional learning communities. In these districts, professional learning communities typically filter district goals, charging their schools with only the most fundamental of these objectives while simultaneously maintaining an ongoing, results-oriented focus on learning and collaborative structures (Fullan, 2001).

Professional learning for the mathematics teachers. Research in the field of mathematics education and professional learning tends to be focused on how teacher learning should be situated within the contexts of the classroom (Borko, 2004), what the subject of that learning should be (Ball, 1991; Kennedy, 1997; Ma, 1999; Shulman,

1986), or how to promote the learning through adult learning theories (Mewborn, 2003). There is a great chasm (Ball & Bass, 2000) in the perspectives regarding which to prioritize—content or pedagogy. Viewpoints differ as to which of these should be the content of professional learning. Pedagogical content knowledge (Shulman, 1986) describes the knowledge teachers need in order to connect content knowledge with pedagogy. Pedagogical content knowledge represents the "close interweaving of subject matter and pedagogy in teaching" (Ball & Bass, 2000). In light of this research, the content covered through professional learning programs varies among four categories: subject matter, teaching practices, content specific pedagogical or student learning knowledge, and goals for student learning (Desimone et al., 2006).

In terms of learning how to teach, a situated approach to the professional learning of mathematics teachers allows a new perspective of teacher growth to occur (Borko, 2004). Professional developers employing this lens would determine whether or not the situations in which teachers were asked to learn would be contextualized. Thus, the classroom itself would become a powerful place for learning because it provides a backdrop for the contextual constraints of learning to teach mathematics.

Content knowledge is a foundational skill for teachers (Ball & Bass, 2000; Desimone et al., 2006; Ingersoll, 2001; Ma, 1999). Professional learning should be used to better equip teachers with weak mathematical content knowledge, particularly those within the mathematical teaching force who hold a less rigorous mathematical background (Desimone et al., 2006; Ingersoll, 2001). Desimone et al. (2006) found a lack of empirical, large-scale evidence in the literature that indicates that content-specific professional learning is being targeted for teachers whose pre-service education and

experience have little mathematical background. The researchers selected and surveyed a sample of 1,218 participants, and found that teachers with a higher content background, based on earning a degree in mathematics, were more likely to pursue content-specific professional learning. More importantly, those who did not have as strong of a mathematical background prior to teaching were less likely to pursue mathematically content-specific professional learning. As a result, this finding indicated that content-specific professional learning programs primarily served those who had a stronger mathematical background and failed to serve less-prepared teachers with a greater gap in content knowledge (Desimone et al., 2006). The mathematics content that teachers know and how they know it (either procedurally or conceptually) impacts their overall teaching knowledge.

What do mathematics teachers need to learn in order to teach mathematics? The authors of the National Council of the Teachers of Mathematics' (NCTM) *Principles and Standards for School Mathematics* asserted that teachers should have a deep understanding of mathematics so as to be able to not only draw on that knowledge, but also to be able to increase their flexibility in their teaching tasks (NCTM, 2000). That being said, literature related to the professional learning of mathematics teachers either focuses on content knowledge, pedagogical knowledge, or both. Several researchers have focused on exploring the relationship between specialized content knowledge and student learning (Ball, 1991; Kennedy, 1997; Ma, 1999; Shuman, 1986).

The importance of how much mathematical content mathematics teachers know, may not be as significant as how they came to know it (Hill & Ball, 2004)—and how they listen to their students (Davis, 1997; Thompson & Thompson, 1994). Content knowledge

is important, and Ingersoll (2001) explained that one out of three secondary mathematics teachers have neither a major nor a minor in mathematics, and that more affluent schools are more likely to have a greater number of teachers with a stronger content knowledge background. Regarding professional learning, Ingersoll also found that teachers not holding a mathematics degree (or mathematics minor) were less likely than their mathematics-major counterparts to proactively seek content-specific professional learning.

Beliefs Systems and Conceptions of Learning and Teaching Mathematics

Three bodies of literature informed the theoretical framework. As previously discussed, goals for professional developers—as authoritative figures, researchers, or teachers themselves—reveal what program reformers (or teachers) critically value as important knowledge for teaching mathematics. Priorities for professional learning focus on either mathematical content or instructional practices; however, the extent to which teachers value these learning opportunities may also influence how they use or embed the goals of this professional learning into their practices or belief systems (Zuzovsky, 2001). To that end, the following frameworks describe theories related to beliefs and knowledge, ways of knowing, and reflection.

Beliefs, knowledge, and knowing. Is there a difference between what one believes and what one knows? Some researchers (Andrews & Hatch, 1999; Green, 1971; Leatham, 2006; Thompson, 1992) offer distinctive differences that can be used to differentiate between the concepts between knowledge and beliefs. Although educational researchers generally use the term “conception” as a category containing other ideas such as beliefs, understandings, meanings, views, and knowledge (Andrews & Hatch, 1999;

Leatham, 2006; Thompson, 1992), throughout this study I distinguished between what one knows, what one believes, and how one believes it (Fenstermacher, 1994; Green, 1971). In particular, Green (1971) asserted that individual beliefs have their place within belief systems and do not necessarily have a truth value per se. One could believe in something that may or may not be true; however, when that person has enough evidentiary information to make a decision about that belief based on actual facts or just thinks he or she knows it, he or she subsequently views that knowledge as true. Green (1971) used the example of believing that there are a certain number of students in a classroom from an estimate, and then knowing how many students are there after physically counting them. Additionally, beliefs may be held in varying degrees of conviction (Thompson, 1992).

Belief systems. Beliefs, or *what* one believes, are relationally connected to other beliefs within a belief system that controls *how* one believes (Green, 1971; Leatham, 2006; Thompson, 1992). Additionally, beliefs within a belief system may be connected through psychological strength or quasi-logical relationships, and may not seem to be consistent with other beliefs (Green, 1971). Psychological strength refers to beliefs being either central or peripheral in that the stronger a belief is (or more central), the more difficult it is to influence. Quasi-logical relationships between beliefs may exist if one belief implies that another belief is true, and thus informs of how one develops and holds his or her beliefs within the belief system (Leatham, 2006). Finally, beliefs may be "clustered, more or less in isolation from other clusters and protected from any relationship with other sets of beliefs" (Green, 1971, p. 48). Thompson (1992) asserted clustered beliefs make cross-fertilization or confrontations between clusters more

difficult. Therefore, conflicting or inconsistent beliefs among these beliefs may occur (Thompson, 1992).

Observers may have difficulty accepting contradictory beliefs in which connections between beliefs or changes to beliefs are not clear. Because beliefs can change based on evidence or merely personal taste (Leatham, 2006; Skott, 2001), incongruences between beliefs within belief systems are sometimes difficult for researchers to document or articulate. For the purposes of this study, knowledge—a subset of all beliefs—is understood to be held within a belief system.

Further, within the field of mathematics, the term "conception" may be used within the contexts of both the conceptions of mathematics and mathematics teaching (Andrews & Hatch, 1999; Thompson, 1992). Conceptions are subconscious or conscious beliefs, meanings, or images of a topic that are based upon personal judgments (Raymond, 1997).

A Theoretical Framework

Overview

As I previously discussed, the term *belief* describes what we know, and *belief systems* describes how we know it (Green, 1971; Fenstermacher, 1994; Leatham 2006; Thompson, 1992). Belief systems are foundational in providing a cognitive context in which a learner can situate him or herself within a learning experience with respect to a learning object and a possible authority figure. The degree to which the learners reflect on the learning process and the degree to which they develop their individual senses of self and voice are contingent upon their development along the larger continuum that embodies their various ways of knowing or reflecting (Belenky Clinchy, Goldberger, & Tarule, 1986; King & Kitchener 1994).

Women's Way of Knowing

Theoretical frameworks used for this study include Belenky et al.'s (1986) Woman's Way of Knowing (WWK), and King and Kitchener's (1994) Reflective Judgment Model (RJM). WWK is comprised of five perspectives (*silence*, *received knowing*, *subjective knowing*, *procedural knowing*, and *constructed knowing*) that frame how a woman obtains knowledge, how she acknowledges herself as a learner or knower, which mode she uses to gather information, and how she perceives and uses her voice as an instrument through the learning process. Belenky et al. (1986) posited that a woman's voice develops as she progresses through each of the five WWK stages. The concepts of voice, mind, and self were metaphorically used to describe a woman's perspective who revealed "their views in the world and their place in it" (p. 19).

Women with a perspective of *silence* do not recognize that they have an inner voice; they therefore feel mindless and voiceless (Belenky et al., 1986). These women completely depend on external authority figures to tell them what is true. *Received knowers* acknowledge their inner voice, yet still turn to external sources for both knowledge and authority. Women who are received knowers listen carefully to others and use their voices to reproduce knowledge for themselves but rarely to speak up. This is progress in the way of knowing with respect to the silence knowing, because now the woman recognizes that she does have a voice, even though she rarely uses it (Belenky et al., 1986).

As women reject authority figures, rebel, and increasingly turn to their inner voices (perceiving those voices as the sole source for all truth), they learn to gain knowledge through *subjective knowing* (Belenky et al., 1986). Women who learn through

subjective knowing define truth through their own personal and private experiences or by making choices via reference to their own intuition. Although these learners become increasingly interested in other's perspectives and values, they do not seek to impose these beliefs on others. Within the fourth perspective, *procedural knowing*, the learner's inner voice gains power and credibility, but she acknowledges that this voice is capable of making mistakes. Procedural knowers both recognize and use their inner voice while also accepting other people as resources. Guided by her voice of reason, the learner strives to see the world as it truly is through either a *separate* or *connected* relational lens. Within this stage, she may use separate knowing, which counters subjectivism, to separate her feelings and emotions in order to remain objective and logical. Unlike subjective knowers who assume that everyone is right, this idea of separate knowing (which is still procedural), assumes that everyone may be wrong, including the knower herself. Through the stance of *separate knowing*, women play devil's advocate to explore and compare various perspectives. Conversely, *connected knowing* may also occur in this stage, as the woman seeks to find truth by connecting to others in order to fully understand their experiences. Unlike the separate knower who doubts everything, the connected knower listens to others and cares about what they have to say. She gains knowledge through *connected knowing* by finding commonalities with others to deepen her knowledge and connect with them on a personal level. In this stage, she begins to value and procedurally examine other people's frameworks for knowledge to compare or contrast these frameworks with her own way of knowing. However, in both connected and separated knowing, she still prioritizes the self-knowledge as most trustworthy resource for constructing knowledge (Belenky, et al., 1986).

Belenky et al.'s (1986) final stage of knowing, *constructed knowing*, occurs when the woman integrates all the best features (such as both connected and separate modes of knowing) of the previous positions in order to examine, shape, and share knowledge. Women begin to view multiple sources, including their voices and other resources, as a means of generating contextual knowledge. In this final stage, women value both subjective and objective knowledge, and they also understand truth to be contextual—not absolute. These women apply connected and separate ways of knowing while acknowledging their voices and minds as central to the knowledge-making process. Women who learn through constructed knowing connect to their inner voices, but they also seek truth through both questioning and dialogue. They illustrate this advanced way of knowing by critiquing arguments, listening with confidence, showing empathy, and balancing their concern for finding deep understanding of what they are trying to learn.

Subjugated knowing. As an extension of Belenky et al.'s (1986) WWK, Hurtado (1996) argued that the ways of knowing for women of color cannot be effectively investigated without the consideration of race, gender, and class. Hurtado (1996) considered both social positionality and oppression when developing what she posited as the position of *subjugated knowing*. *Positionality* is a stance where the development of knowledge is context-specific—where the position of the learner is dependent on how her gender, race, and class interact with others who may or may not assert society domination (Maher & Tetreault, 1997). Hurtado (1996, p. 372) asserted that women of color use *subjugated knowing*, a way of knowing that embodies "special mechanisms of knowledge production and knowledge acquisition," where the mechanisms for gaining knowledge may or may not overlap with Belenky et al.'s WWK. Hurtado posited that this position

characterizes commonalities among women of color who temporarily resist “structures of oppression to create the interstices of rebellion and potential revolution” (p. 386). She noted that women of color use subjugated knowing via the five mechanisms of *anger, multiple voices, withdrawal, shifting consciousness,* and *multiple lenguas.*

The five mechanisms for subjugated knowing. The first mechanism, *anger*, manifests itself in the knower as she recognizes an inherent stigma associated with her race, gender, or class as imposed upon her by others, even within her own cultural group. The author states that the learner intuitively senses danger and keeps it at bay through anger. Hurtado (1996) pointed out that, “What privileged White men learn at the university—that all truth is relative—is quickly learned by many women of color, whose portrayal in different spheres of society never quite ‘jibes’ with their internal reality” (p. 378). It is this anger that can either block or unlock access to their own knowledge, and women of color aim to bridle this ongoing anger from hurting undeserving others. In one example of this anger going unconstrained, Hurtado (1996) recalled observing an African American woman who “burst into screams” at an airline ticket agent who refused to check her oversized luggage. When a supervisor was called, the African American woman called the supervisor a racist and indicated that she was going to patronize a different airline. However, a “rich White” woman with several bags of luggage was accommodated after she persuaded the agent to bend the rules for her. Hurtado (1996) pointed out that as women of color become increasingly aware of such relativity, their anger may lead to group conflicts or intragroup solidarity.

Another mechanism used with subjugated knowing is multiple voices. Similarly to WWK (Belenky et al., 1986), women develop their voices as their way of knowing

evolves. However, women of color develop different or *multiple voices* in which to establish their identity within several different circles of belonging (Hurtado, 1996). They struggle to balance several voice stances, such as silence, outspokenness, or talking back, while trying to represent themselves truthfully. Silence becomes a powerful tool by which women of color learn information about other communities, and then relay and verify what they have learned with their fellow community members. Being outspoken is equally powerful, as the learner, who may not be expected to speak, exercises her abilities to sharpen debating skills and articulate her thoughts. Women of color use both silence and outspokenness to develop private and public knowledge and *withdraw* or separate themselves from men in order to develop their own sense of authority (Hurtado, 1996). Using examples from her own family, Hurtado (1996) recalled the women in her family who had leadership roles in making money for the family by selling pigs or who took risks by independently venturing to the United States to pursue their careers or to support their families. The final mechanism, *multiple lenguas* (or tongues), is the ability to speak to within different communities while maintaining coherence. Women of color are uniquely capable of seeing multiple perspectives of an argument concurrently (Hurtado, 1996), and recognize that what may be true within some contexts may not be true in others. Instead of placing authority figures into a separate position of power, women of color recognize others who are in a position of power within a larger, unchanging context of oppression.

Perry's Positions of Intellectual Development

Because one of my participants was male, I also chose to reference Perry's (1968, 1999) stages for intellectual development to analyze how this participant situated himself

with authority figures or professional learning. Perry's (1968, 1999) Positions of Intellectual Development include nine different positions that are bundled within four major positions: *dualism*, *multiplicity*, *relativism*, and *commitment in relativism*.

A *dualistic* view of learning revolves around getting a correct answer. Authority figures remain unquestioned. Learners in the position of *multiplicity* begin to distrust authority figures while also accepting that uncertainty produces knowledge and that some elements will remain unknown. Within the third position, *relativism*, knowers view knowledge as contextual. In the final position, *commitment in relativism*, learners commit to relativism when they realize that knowledge generation is actually a process of a series of choices presented through multiple contexts and perspectives (Perry, 1968, 1999; Perry, Donavan, Kelsy, Paterson, Statkiewicz, & Allen, 1986).

The Reflective Judgment Model

King and Kitchener (1994) labeled the first three stages of their Reflective Judgment Model (RJM) as *pre-reflective*. In Stage 1, learners obtain absolute knowledge through observations and do not perceive alternate views of knowledge. A knower moves into Stage 2 of the RJM when the knowledge they hold, either gathered from an authority figure or derived from their own senses, is absolute; however, that knowledge may not all be available. In Stage 3, in which knowledge is assumed to be absolutely certain or uncertain, knowledge is still gained solely from an authority figure. The next two stages, Stage 4 and Stage 5, are grouped as *quasi-reflective thinking* (King & Kitchener, 1994). The quasi-reflective stages describe individuals who acknowledge that some problems are ill-structured, yet they struggle to use evidence to draw reasoned conclusions or to justify their beliefs. Stage 4 is characterized by that knowledge being uncertain due to

situational or individual variables and that knowing anything involves some level of ambiguity. In Stage 5, knowledge is viewed through a contextual and subjective lens to interpret evidence and events through the process of inquiry in order to make a judgment.

The final two final stages, which comprise the category of *reflective thinking*, describe a knower who constructs knowledge in order to explore an ill-structured problem. Stage 6 is characterized by learners who construct knowledge via multiple sources after some investigation of an ill-structured problem took place. Beliefs are then justified by comparing, evaluating, and weighing evidence within the context of that problem. Finally, in Stage 7, learners gain knowledge through process of inquiry by which reasonable solutions are constructed to address an ill-structured problem. These learners evaluate evidence within the context of the problem to question both knowledge and how the knowledge was developed. Learners develop well thought-out conclusions, and they may defend and represent their conclusions as complete and plausible based upon the received evidence.

Each of these frameworks also offers an interesting theoretical structure for ways of knowing within different contexts: ways of knowing as women, women of color, or men. Each framework has stages ranging from the lowest stage, at which learners do not perceive themselves as sources of knowledge, to the highest stage, where self-motivated learners construct meaning and knowledge from multiple internal and external sources. As learners move from one end of the continuum to the other, knowledge evolves from being received from external sources to internal voices, and then finally to an integration of multiple sources. The process of learning goes from being transmitted, to being constructed, to finally being formed through inquiry-based problem-solving. The notion

of knowledge also slides along a continuum from an absolutist lens, where it is thought of as concrete, fixed, and static, to a fallibilist lens, by which the learner can critically develop and work with open-ended, change-based, and multi-faceted solutions.

The concept of authority also is situated within each of these theoretical frameworks. Knowers initially accept or receive knowledge from an authority figure out of fear (as a defense mechanism) or out of trust. Then they reject this source of knowledge and look subjectively to themselves as a source for knowledge. Finally, after the learners recognize that other people may offer perspectives that could both deepen and broaden their personal perspectives, learners collaboratively seek other perspectives to reject, connect with, or integrate into their own ways of knowing. Collaboration in these final stages works as a mechanism that allows learners to freely explore multiple avenues of knowledge in order to critically reflect upon, judge, or make a decision about the beliefs they hold.

Each of these frameworks suggest a notion of development in terms of categories in which one can move from one stage to the next or even skip stages. One striking difference between the theoretical frameworks is how knowers develop through their ways of knowing with respect to cooperative learning. Within WWK, as women progress through each stage of knowing, they situate themselves in particular ways with respect to other people—first with believed authority figures, then themselves, and finally with other non-authoritative people—in order to inform their own ways of thinking. Likewise, King and Kitchener (1994) suggest that as people progress through the reflective stages, they change their ways of forming knowledge from an absolutist perspective to a fallibilist view in which learners construct knowledge after considerations have been

given to evidence and the "opinions of many others" (p. 15). In both WWK and RJM, as learners progress from one developmental stage to the next, their ways of knowing change and their social circle from which they draw reflective insights to construct knowledge also expand. Commonalities among the final stages within both WWK and RJM illustrate how newly open-minded learners realize that they are their own authority, and that their interpretations of quality and accuracy of their knowledge is enhanced through the consideration of other people's perspectives.

Conceptions of Teaching and Learning Mathematics

Conceptions of mathematics. Personal beliefs are a crucial component to understanding a teacher's philosophy of mathematics. This philosophy of mathematics influences how teachers perceive mathematical knowledge, the origins and nature of mathematics, mathematical applications, and mathematical practice (Ernest, 1994). Teachers' beliefs about the nature of mathematics, the nature of learning, and the nature of mathematics teaching inform their daily practices and the way they approach professional learning. Although little research has been conducted to understand the depth of teachers' mathematical beliefs (Andrews & Hatch, 1999), the investigation of this belief system may reveal how teachers' beliefs of mathematics shape their instructional practices (Thompson, 1992). Moreover, considering teachers' philosophies of mathematics may also illuminate how teachers make decisions about their own professional learning.

Fenstermacher (1994) offered one perspective of two types of knowledge: "propositional knowledge" —knowing *what*—and "practical knowledge" —knowing *how*. Propositional or informational knowledge can be thought of as a type of scientific

knowledge, which is sometimes viewed as competence knowledge. In contrast, practical knowledge is situational and is bound contextually through actions during a particular moment.

Within the content of mathematics, propositional knowledge is analogous to content knowledge whereas practical knowledge relates to procedural knowledge. These types of knowledge provide support for Ernest's (1995) absolutist perspective for viewing the nature of mathematics. The absolutist conception is passive and views mathematics as complete, having an absolute truth, and separated from other disciplines. In contrast, Ernest's second theory for looking at one's perspective of mathematics is the fallibilist standpoint, in which a more active approach asserts that mathematics is open-ended as evident in both mathematical concepts and proofs (Ernest, 1995; Andrews & Hatch, 1999). Lerman (1998) pointed out that these conflicting views have implications for pedagogical practices. Absolutists, seeing mathematics as complete and fixed, will assume authority over the subject matter, and instructors that hold this concept will assume that mathematical knowledge should be transmitted to their students. Fallibilist activists, however, attempt to illustrate that mathematics is connected with human history, values, and with all knowledge. Educators will use constructivist techniques within their practices to construct their knowledge as teachers of mathematics through explorations, collaboration, and problem-solving activities, thereby conveying these concepts to their students (Lerman, 1998).

Additionally, Ernest (1995) asserted three views as conceptions of mathematics: the problem-solving view, the Platonist view, and the instrumentalist view. Among these, the problem-solving view is aligned with the fallibilist view in that those who hold this

perspective continually view the nature of mathematics as a work in progress and open to revision. The other two views, the Platonist view and the instrumentalist view, are consistent with the absolutist perspective, which states that mathematics is conceived as predetermined and existing without human discovery, and made of useful rules and facts that aid in "doing" mathematics.

In the literature related to professional learning, many reformers developed pedagogical goals that were consistent with the *Standards* documents of the National Council of Teachers of Mathematics (1989, 1991, 1995, 2000), which illustrated how to "teach mathematics with a human face" by teaching mathematics from an open-ended perspective and adapting the material to the learning needs of every child (Sfard, 2003). This perspective of mathematics was consistent with the fallibilist view, in which mathematics is viewed as a problem-solving activity within an open-ended, ever-expanding, flexible, and inter-connected discipline.

Conceptions of learning mathematics. Educators' conceptions of mathematics are related to and influence their conceptions of learning mathematics. For example, when viewing mathematics as fixed, a teacher holding an absolutist conception of mathematics may view the process of learning mathematics as hierarchical, meaning that some skills and knowledge must be learned prior to learning subsequent knowledge. Ernest (1994) pointed out that this perspective of learning was supported by Piaget's (1970) four stages (sensory-motor, pre-operational, concrete operational, and formal operational) of intellectual development, in which the learner must master one stage before going to the next. Additionally, once a learner had mastered one stage, they could

not return to previous stages again. Thus, this is a linear trajectory of cognitive development, with no specific teenage or adult considerations of learning.

The perspective of learning described above is problematic in that it makes two assumptions about the nature of learning mathematics. First, this perspective assumes that learning entails acquiring skills**,** and secondly**,** that the mastery of those skills is dependent on the mastery of some prerequisite knowledge. Neither of these assumptions, based on learning hierarchies, is supported theoretically nor empirically likely because "no one hierarchy best describes the sequences or structure of every learner's knowledge acquisition" (Ernest, 1994, p. 239). Other criticisms suggest that a learner's knowledge must either include prerequisite knowledge to build new knowledge upon or lack mathematical concepts so that what is learned may begin with a fresh slate; however, Ernest contended that learning occurs as a process of growth through the construction of knowledge, and this construction is both personal and unique.

Other theories, particularly modern and structural learning theories, are also aligned with absolutist perspectives of mathematics. From a modernist perspective, mathematics is developed through accurate representations with abstract structures and formal systems to define the autonomy of mathematics (Tymoczko, 1994). Structural theorists assert that mathematical knowledge develops from the acquisition of the processes of mathematics and structures (Ernest, 1994). Thus, from both modern and structural standpoints, learning is defined as mastering bodies of knowledge or procedures and both seem to ignore the human element of learning.

Within the context of Vygotsky's social learning theory, the notion of learning and learning mathematics was revived (Lerman, 2001). With thinking and language being

noted as interdependent activities, cognitive growth was conceptually linked through social interactions (Lerman, 2001). Post-modern and post-structural theorists began to reject previously held absolutist perspectives of learning, thus fomenting a surge of fallibilist perspectives of mathematics wherein the intuitive and interactive mathematical learning processes were explored (Tymoczko, 1986). As a result, the view of learning mathematics shifted from learning bits of information to learning about mathematical relationships. Students were expected to seek solutions, explore patterns, and formulate conjectures rather than merely memorizing facts, procedures, and completing activities (Schoenfeld, 1992).

As the views of mathematical learning began to evolve, so did the perspectives on assessing mathematical learning. During the modern and structural eras, if a student could produce an accurate answer to a problem, the teacher would assume that he or she accurately learned mathematics as the correct answer was considered to be sufficient justification for learning. However, after the perspective of assessment shifted from product-based to process-based, more research began to focus on assessing students' mathematical thinking. Mathematical understanding cannot be achieved—it can only be developed. In 2000, the National Council of Teachers of Mathematics provided the *NCTM Principles and Standard for School Mathematics* that identified the five Process Standards for promoting mathematical understanding: problem solving, reasoning and proof, communication, connections, and representation. Through these standards, students were expected to use problem-solving strategies, use various methods of proof and reasoning, make mathematical connections, and use multiple representations to solve problems to learn mathematics.

This perspective of learning transformed the role of the learner. The learner's role changed from being a passive listener who received instructor transmitted knowledge, to becoming an active participant in the learning process who produced evidence of his or her mathematical understanding through writing and mathematical communication (Lampert & Cobb, 2003). Traditional teachers, often associated with absolutist views of mathematics, usually delivered mathematical content using a single method intended for the masses. In contrast, reform-oriented teachers—those whose views of mathematics are aligned with fallibilistic perspectives—required students to problem solve, use and create multiple representations, and collaborate to blend "idiosyncratic and conventional representations" to solve contextual problems (Smith, 2003, p. 263). Furthermore, mathematical reasoning is established and fostered through mathematical communication and arguments between peers. Mathematical reformist literature describes learning mathematics as a process whereby students collaboratively problem solve, investigate and validate conjectures, and properly use discourse to improve their individual and collective mathematical knowledge (Ball & Bass, 2003).

Conceptions of teaching. A teacher's concept of mathematics teaching includes mathematical learning goals, his or her role as well as the student's role in the teaching-learning process, classroom activities, instructional practices, desired outcomes, and mathematical procedures (Thompson, 1992). Teachers' conceptions of teaching may also influence how they reflect their views of student knowledge and how teachers learn mathematics. In research involving pre-service teachers, some suggest that teachers' conceptions of teaching are deeply rooted and formed based on their prior learning experiences as students (Ball & Feiman-Nemser, 1988; Thompson, 1992). These

conceptions of teaching, which may be resistant to change, are framed by beliefs through reflective practices to inform their models of teaching and learning (Andrews & Hatch, 1999; Cooney, Shealy & Arvold, 1998; Ernest, 1999).

The literature suggests several models of teachers' conceptions of teaching mathematics (Andrews & Hatch, 1999; Blaire, 1981; Ernest, 1994; Kuhs & Ball, 1986). These models illustrate how teachers view their roles as practitioners and how their conceptions of learning mathematics inform the way they situate themselves within the teacher-student relationship. One model suggests that teachers orient themselves as teachers based upon whether they view mathematics as a game, an art, a science, or a technology (Blair, 1981). Based upon teacher conceptions of mathematics, Ernest (1994) offered another model in which teachers perceive their role through a spectrum of five different ideologies of education—*the industrial trainer*, *technological pragmatist*, *the old humanist*, *the progressive educator*, and *the public educator*. Industrial trainers believe that mathematics holds true to sets of rules, student ability is fixed and inherited, and the teacher's role in the classroom is to transmit knowledge to students through practice and drills. To the industrial trainer, students learn mathematics through hard work and effort. Technological pragmatists, who also believe that students inherit their mathematical abilities, argue that mathematics is an unquestioned body of applicable knowledge. This group believes that mathematics is learned through practical experience, and therefore, aim to motivate students while building mathematical skills through mathematical applications. Those who Ernest (1994) classifies as old humanists believe that pure mathematics is a structured body of knowledge, learned through understanding and applications by those who have an "inherited cast of mind" (p. 139). These educators

focus on explaining, motivating, and passing on this structure to their students. Progressive educators personalize mathematics because they view it as a process, believing that a child's mathematical ability varies, but should be nurtured. These teachers created more child-centered classrooms where students learn mathematics through activity, play, and exploration. Finally, the public educator views mathematics as a means for social constructivism where the ability of the child is fixed. These educators teach through questioning and decision making in order to facilitate discussions and critical thinking skills. In this classroom, mathematics must be authentic and socially-relevant to their students (Ernest, 1994).

Kuhs and Ball (1986) developed a model that more explicitly identifies the teacher's relationship with the student through four models of teaching: *learner-focused*, *concept-focused*, *content-focused*, and *classroom-focused* (Andrews & Hatch, 1999). Within the learner-focused model, mathematics teachers focus on helping students personally construct their own mathematical knowledge. The content-focused model places an emphasis on content specific and conceptual mathematical knowledge. Both of these models of teaching mathematics exhibit a more fallibilist view of mathematics. In contrast, the content-focused and classroom-focused models align more with the absolutist views of mathematical content, in that these center on either presenting mathematical content for the purposes of content mastery or for the mastery of procedures or skills (Kuhs & Ball, 1986; Thompson, 1992).

The reform literature suggests that there are commonalities among all these models, and that teachers should more closely align themselves with a facilitator role, not the knowledge-dispenser role, so that students can create their own mathematical

knowledge and conceptual thinking through mathematical engagement (Lampert & Cobb, 2003). Ideally, conceptual understanding should be formed by the students, not the teachers, and teachers should tend to and modify instruction to fit the individual needs of all their students (Ball & Bass, 2003).

CHAPTER 3: METHODOLOGY

The Multi-Site Case Study Methodology

This study was a multi-site case study. Although some case studies are a process of inquiry (Yin, 2009) or an end-product (Wolcott, 2001), the term *case study* in this study was identified through the bounded system of the case itself (Merriam, 2009; Stake, 1995). The case defined in this study was a small group of secondary mathematics teachers in high performing schools. Their beliefs toward professional learning were explored through a unit analysis by which the data collection process incorporated interviews, photographs, participants' written reflections, and additional literature on topics that emerged from the findings (Merriam, 2009). Furthermore, this case was bounded, not only by the finite population from which I chose my sample, but also bounded in that it explored an "instance of a process, issue or concern" (Merriam, 2009), which in this case is the beliefs of the participants toward professional learning.

Study Design

Site Selection

In the era of NCLB, the definition of high performing schools has been reduced to a simplistic definition. For example, in order to assign National Blue Ribbon Awards to high performing schools, the program developers defined *Exemplary High Performing* schools as schools that are among "their state's highest performing schools, as measured by state assessments or nationally-normed tests" (United States Department of Education [USDOE], 2011). Therefore, in the present study, this definition formed the basis for

identifying two high performing schools in the Southeast region of the United States. Both schools were located within the same school district and had equal access to mandated or voluntary opportunities for professional learning. Additionally, beyond the simplistic definition of exemplary high performing schools offered by the USDOE academic, athletic, and artistic fields. These additional awards and honors underscored the well-rounded achievements of the sites chosen for the study and reinforced that the selected schools were dynamically successful.

The two sites in the study were selected from a group of schools awarded the "highest performance" status through the state's accountability system by which all schools in the state were evaluated. Both sites were public schools, each over 30 years old, and situated in the same suburban, middle-class, residential community located just outside of a metropolitan area. The average annual income for families within these two school districts is between $75,000 and $115,000. Sites 1 and 2 offered nearly twenty different athletic programs, over 30 clubs for extracurricular activities and have been recognized nationally and internationally for their fine arts and music departments. Academically, both sites have been awarded the National Blue Ribbon School of Excellence award, the Siemens Award, and offered a wide variety of Advanced Placement (AP) courses.

Site 1. Site 1 was large high school that was originally built for a student body size of around 2,000 students; since its opening during the 1970's, the school's ongoing and varied academic and athletic accomplishments has attracted more families to move into the school district. During the time of the study, the student enrollment was nearly 2,700 students, and was comprised of the following groups: Caucasian (73%), Asian

(15%), African-American (6%), Hispanic (3%) and Other (3%). In spite of growing concerns over cramped facilities, Site 1 maintained a reputation for being one of the highest performing schools in the state. Site 1 leads its county in SAT scores and Advanced Placement scores. Among the 160 certified staff and faculty members, nearly 90% held post graduate degrees. The Parent Teacher Association had a strong voice within this community, as it had 100% enrollment most years. Parents frequently volunteered to work in the main office, made copies for teachers, or assisted in other managerial jobs around the school.

Site 2. Site 2 was as academically successful as Site 1. Along with high SAT scores, it also had a strong fine arts program. In particular, the school's marching band often received high state and national rankings each year. The student body, approximately 2,000 students, was comprised of Caucasian (77%), African-American (11%), Asian (4%), and Hispanic (5%) and Other (3%). Like Site 1, Site 2 was successful across many domains: academics, fine arts, and athletics. Since its opening in the early 1980's Site 2 had won over 20 state championships in athletics, and also had won musical accolades within both state and national competitions.

Performance on high-stakes tests does not necessarily guarantee that a school is high performing overall; however, both sites, although differing in student enrollment, had commonalities in that they were in the same school district and served similar student bodies. Success at both of these sites was defined not merely through academic performance, but also through their offerings of award-winning fine-arts and athletics programs. I chose the mathematics teachers at both sites because as I was particularly interested in their motives and beliefs toward professional learning. Additionally, these

teachers were teaching within schools that were already recognized for being successful. What professional struggles do teachers face when teaching in these environments? What conceptions of success and professional growth do they hold while teaching in schools that are considered to be “high performing” schools? Do they even think they should improve their practice at all? Because both sites were within the same school district, both mathematics departments would have the same opportunities for district mandated or provided professional learning. Would teachers within different schools, but the same school district, have similar or contrasting perspectives on professional learning, and to what degree would their perspectives be influenced by their interactions with school leaders?

Therefore, the mathematics teachers considered for this study were purposefully selected due to their school’s high-performance status and school district because these teachers were exposed to the same professional learning opportunities through the same school system. Individual school structures, administrative roles, or department goals would also potentially illustrate differences among the beliefs of the participants about professional learning.

Participant Selection through a Survey

In order to investigate the participants’ beliefs and attitudes toward professional learning, I developed a five-stage data collection process. Each phase provided a different avenue for data collection. In sum, the data included survey responses, interviews, photographs, and reflections of, questions about, and responses to selected readings through emails, blog responses, and follow-up conferences. Surveys were distributed to the mathematics departments at Sites 1 and 2. Although this study was based upon a

qualitative paradigm using qualitative methodologies, a quantitative survey that included open-ended questions was used to help the researcher select a purposeful, criterion sample. At both locations, I requested the department chairs distribute the initial survey during a department meeting. The survey instrument contained seven items related to descriptive statistics, 20 multiple-choice questions (Lischka, 2012) designed to measure the participants' mathematical philosophies, and five open-ended questions in which participants described their school, professional learning, and vision of an ideal mathematics teacher using three adjectives or phrases. Other questions allowed teachers to further elaborate on these perspectives.

With respect to the 20 multiple-choice items, I embedded items from Lischka's (2012) Mathematical Teaching Pedagogical and Discourse Beliefs Instrument (MTPDBI). These items were specifically designed to be analyzed using Item Response Theory (IRT) in order to identify where respondents fell along a continuum of teacher-centered to student-centered philosophies of teaching mathematics. Specifically, the instrument employed the Rasch measurement model of Partial Credit (Wilson, 2005) to designate a measurement for the persons and instrument items in terms of *logits*, which expresses the likelihood of success for a person within each item. *Success* means the extent to which the participants selected answers representing defined categories along a construct's continuum. For this survey, the construct was a philosophy of teaching and learning mathematics, but the categories for this construct varied from a completely teacher-centered view of teaching mathematics to a completely student-centered perspective of teaching mathematics. Each of the survey's multiple-choice items prompted participants to select one choice among four, where each of the choices closely

aligned with varied stances on the nature of mathematics, teaching mathematics, and learning mathematics (Ernest, 1994).

An educator's philosophy of mathematics (Ernest, 1994) is a deeply held belief that guides her or his conceptions of the nature mathematics, learning mathematics, and teaching mathematics. Although the perspectives may be blended, the instructional practices of educators with starkly different philosophies can be observed through how teachers situate themselves in their classrooms, how they interact with their students, how they assess their students, and how they believe their students learn mathematics. For example, if a mathematics teacher feels that mathematics is fixed, static, and closed, that teacher will be more inclined to assess his or her students on the basis of whether or not they can produce the correct right answer on a test; however, if this mathematics teacher feels mathematics is open-ended, flexible, and changing (meaning that he or she takes a fallibilist perspective), he or she is less likely to look to the course textbook as the sole authority of mathematical knowledge (Ernest, 1994). The entire classroom structure, interaction and the assessments of this teacher's students will also be influenced by this perspective. Worksheets become problem-based activities. Tests may become presentations, and teacher-centered instruction could become a student-centered learning community.

Combined with the multiple choice items, all of the questions on the survey allowed me to choose a criterion sample (Creswell, 1998; Miles & Huberman., 1994) of self-selected participants who varied in their MTPDBI score and their responses to the open-ended questions. Because my study aimed to elicit detailed responses from my participants through interviews, reflective notes, photographs, and blog entries, I gave

greater consideration to participants who gave detailed elaborations of their perspectives through the free-response items on the survey.

At each site, the surveys were distributed and collected during a typical mathematics department meeting. There was a 65% response rate at Site 1 and a 100% response rate at Site 2. At Site 1, I was given a few moments at the end of a department meeting right before the meeting was to be adjourned. After distributing the surveys and answering questions about the study, several teachers indicated they would complete the survey at a later time.

The department chair at Site 2 requested that I deliver the surveys to him in advance, and suggested a time at which I could come to the site to explain the study procedures and answer any questions that the mathematics teachers at his school had. He held a specific department meeting for the sole purpose of allowing me to distribute the survey and discuss the study in detail. When I arrived, each member of the department was seated and already looking over the survey. After I answered their questions about the survey, the consent forms, and the details about possibly participating in additional phases of the study through interviews, reflections, and blogging, each teacher stayed to complete the survey and returned the surveys to me on the spot. The day after I completed and collected the surveys, I realized that three of the free-response questions were not copied correctly on the last page. At Site 1, I hand-delivered the survey to each participant. However, at Site 2, the department chair requested that I deliver the last page of the survey so that he could give it the other teachers. When I returned to collect each of the revised final pages, he gave me a stacked pile of completed survey pages that he had alphabetized for me.

I obtained consent to conduct my study from both my university's Institutional Review Board (I.R.B) and the sites' school district late in the spring semester of the school year. The I.R.B is a federal institution designed to oversee and regulate research activities involving human subjects. This board grants permission to researchers to conduct studies once researchers provide evidence that human subjects will be treated ethically and in compliance with all federal and state regulations. The approval process from both institutions took approximately six weeks and consequentially restricted my timeframe for gathering most or all of my data before the end of the school year. I wanted to be considerate of my participants' demanding schedules and still collect as much rich data as I could. There was no guarantee that the participants would be returning to the same respective schools the subsequent school year, so I sought to gather most of the data before the end of the year.

I employed a *criterion sampling* strategy (Creswell, 1998; Miles & Huberman, 1994) to choose my participants. Qualitative researchers use *criterion sampling* to build in quality assurance by requiring all cases to meet common criteria (Creswell, 1998; Miles & Huberman., 1994). I intentionally sought reflective or descriptive participants who espoused different views of teaching and learning mathematics. Among all the teachers who volunteered to participate in the study, I identified teachers who possessed varied perspectives of teaching and learning mathematics by examining their raw score averages of the multiple-choice items on the survey. I also considered choosing teachers who provided unique and descriptive responses on the free-response survey items. My rationale for using this criterion sample was to explore mathematics teachers' perspectives of professional learning through their rich descriptions using several

reflective activities. Participants would be asked to describe professional learning through interviews, photographs, discussion board postings, and through journaling activities. Therefore, I believed that teachers who provided minimal or no responses on the free-response items would be less likely to provide rich or complete responses throughout the study.

By the time I collected the surveys and determined which teachers were interested in participating in other aspects of the study, I only had approximately 10 weeks left in the school semester. Under this time constraint, I chose to determine the survey participants' raw score average on the 20 multiple choice questions instead of using the *logit* score. In order to determine the logit score, I would need to calculate the scores of my participants with respect to other data already collected by Lischka (2012) in order to make the logit scores more meaningful. (Logit scores are more meaningful as the population size of the study increases.) Therefore, I would need additional support from other colleagues and additional participant data (that I did not have access to at that time) so that I could compute this measurement before selecting participants for my study. I decided to use the raw score from the MTPDBI (Lischka, 2012) items to ascertain an estimate of the potential participants' perspectives of teaching and learning mathematics. I also considered the participants' years of mathematical teaching experience, and the degree to which their responses on the open-ended items on the survey were reflective or detailed. When choosing a participant between two or more teachers who maintained similar raw scores, I chose the participant who was the more reflective, descriptive, or unique in his or her responses on the open-ended questions.

At Site 1, 13 of the 20 mathematics teachers completed the survey, and among them, five teachers indicated that they were willing to participate in subsequent parts of the study. From these five teachers, I chose three teachers, Betty, Mary, and Lucy (pseudonyms), to participate in the next phases of my research. Nine of the 17 teachers at Site 2 were also willing to continue their participation in later parts of the study, and among the nine, I selected Helen, Laura, Ed and Ellen (pseudonyms).

After choosing my participants, I did calculate the logit scores of the participants to verify that these participant selections truly exhibited varied views of mathematics teaching and learning. These results, illustrated in Figure 1, were surprising. For example, Betty had more teacher-centered perspectives of teaching mathematics than Ellen who, according to the survey, having the highest among all the raw scores, maintained a more student-centered philosophy of education.

I labeled respondents who had completed the MTPDBI prior to this study with "00." Potential mathematics teachers from Site 1 (labeled 1–22) and Site 2 (labeled 23–41) had logit scores across the entire continuum. Missing values between 1 and 41 were assigned to teachers' surveys at Site 1 who did not complete the survey. The labels for selected participants, Betty, Mary, Lucy, Helen, Laura, Ed, and Ellen, were replaced by the first two letters of their assigned pseudonyms (i.e., Betty is represented by "BE"). As the table shows, Ellen had the highest logit measurement among the total 174 survey participants. Additionally, Betty had one of the lowest logit measurements among all the participants.

When I compared the logit scores to the participants' raw scores, I concluded that although the raw score appeared to be an appropriate estimate as to where the participants

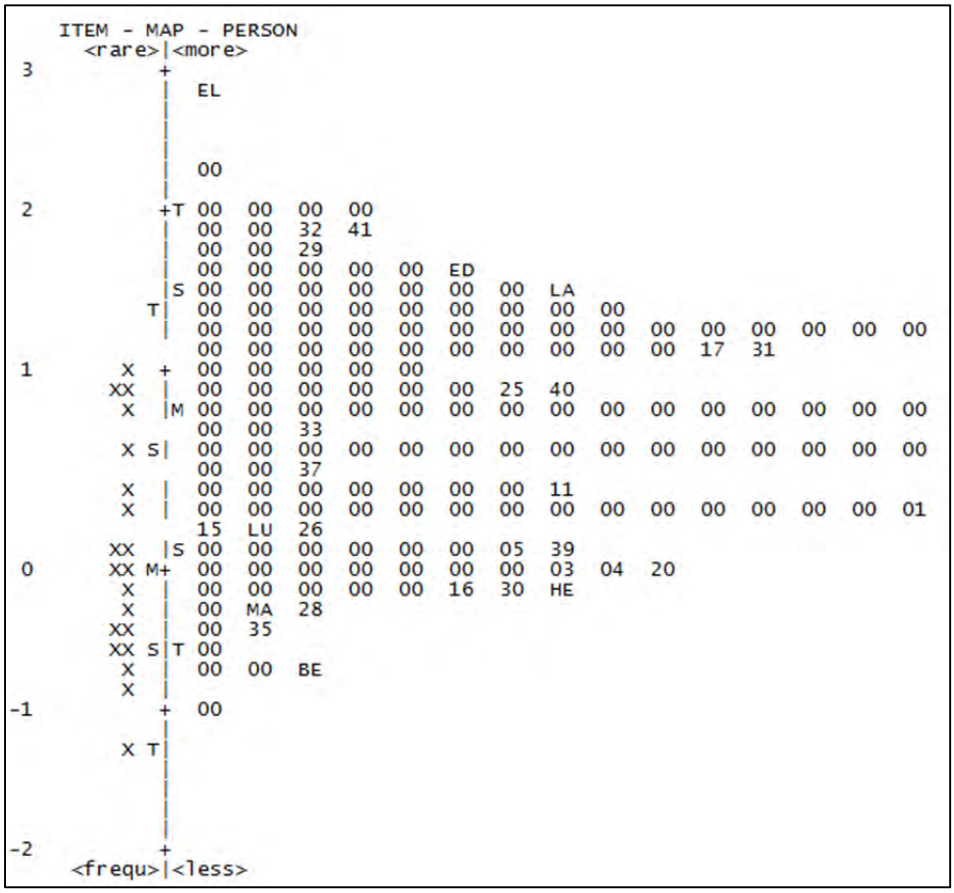

Figure 1. Wright Map for the Study Participants

fell with respect to each other along the beliefs continuum, it was a poor indicator of where the participants' logit measurements were distributed along the mathematical philosophy continuum. Table 1 summarizes the differences between the raw scores and the logit measurements.

Regardless of the participants' logit scores, I maintain that the criterion sampling strategy of choosing participants with varied perspectives (assessed through the multiple-choice items) and detailed descriptions (from the free-response items) effectively guided me to choose a sample of teachers who provided rich descriptions and unique perspectives of professional learning.

Table 1
Summary of Participant Survey Measurements

Measurement	Betty	Mary	Helen	Lucy	Laura	Ed	Ellen
Raw Score[a]	2.11	2.35	2.5	2.75	3.35	3.4	3.74
Logit Score[b]	-0.66	-0.31	-0.1	0.27	1.44	1.58	2.84

Note. Participants are listed in order by their measurement values and not by their teaching site.
[a]The raw score represents the average score calculated by assigning the values one, two, three, and four to each of four item choices. The minimum value for the raw score is one and the maximum value is 4.
[b]The logit score is calculated along a sliding continuum. The construct continuum does not have a maximum value or a minimum value. However, all of the calculated logit scores of previous respondents, potential participants, and Betty, Mary, Helen, Lucy, Laura, Ed, and Ellen fall between the values of negative one and three.

Data Sources and Data Collection Procedures

Photo-Elicitation Interviews

Once I selected the participants, I conducted on-site, semi-structured interviews. I utilized the Photo-Elicitation Interview (PEI) techniques as described by Chao (2012). I gave each teacher a disposable camera and prompted them to "capture your world of learning how to teach mathematics." I asked them not to take pictures of people, students or any identifying factors of the school. I then scheduled one semi-structured PEI interview with each of the participants over the next three weeks. A few days before the interview, I arranged a time to collect the cameras from the participants. I transferred the photographs from the cameras onto a compact disc in order to upload each participant's photographs into a word processing document.

Ultimately, five of the seven participants used the provided disposable cameras. One participant, Laura, chose to use her own digital camera and email me her photographs. Another participant, Ellen, used digital media in lieu of the photograph because she struggled to take photographs of professional learning without taking photographs of people. Therefore, she opted to find clipart or advertisements for

professional learning online. Because she used clipart instead of taking photographs, she used a word processing document to organize her photographs. Additionally, as she compiled her pictures, she typed a reflective description of their relevance to professional learning. I coded all the participants' photographs, and any additional documents or commentary that they provided.

Before the interview, either within a couple days or a few moments prior to the interview, I informed each participant that we would only have time to discuss a few of their photographs, and prompted them to prioritize or choose photographs to discuss from among their photographs. Although some participants took more than 15 photographs, others took fewer than 10. In the cases in which the participants took only a few photographs, I asked them to rank the photographs, in some meaningful way, relating to professional learning. As the interview progressed, we discussed each picture, one at a time, as I asked non-evaluative, non-judgmental questions (Merriam, 2009; Stake, 1995; Yin, 2009). After we discussed their photographs, I asked additional questions that prompted the participants to articulate professional goals, discuss how they situate themselves within professional learning experiences, and elaborate various professional learning experiences that were or were not meaningful. Additionally, I generated open-ended scenarios in which the participants reflected upon how they would develop the skills or knowledge needed in order to teach a mathematics course for the first time. The interviews were recorded and transcribed for later analysis. Digital photographs were analyzed and coded, and I also developed research memos to record how the participants rejected, incorporated, and prioritized the photographs for the interview. I analyzed all the photographs even if the participants did not discuss them during their interviews;

however, I embedded the photographs discussed by the participants within the interview transcripts for additional analysis.

The Professional Learning Journal

Immediately following the interview, participants also received a Professional Learning material kit (Figure 2) containing a Professional Learning Journal (PLJ), Post-It® notes, a highlighter marker, an ink pen, a note pad, and a file folder with information about the Professional Learning Discussion Board.

The PLJ contained nine articles on the topics of: Collaboration and Learning Communities (Chapter 1), Models of Professional Learning (Chapter 2), Professional Learning and Mathematics Education (Chapter 3), and an Appendix (Chapter 4) containing references, discussion board guides, and blank copies of consent forms. Each of the nine articles included in the PLJ, approximately four to 10 pages in length, were

Figure 2. The Professional Learning Materials Kit

accompanied by a Reflective Notes Sheet that prompted the participants to reflect about the readings. I encouraged the participants to highlight at least one quote that they found provocative or interesting, and to reflect about the quote or the whole article, either within the margins of the article itself, on a Post-It note, or on the provided Reflective

Notes Sheet. I also explained that the blog would prompt them to think about applications of these topics within their context of teaching. Therefore, they should have these articles handy as a reference, not requirement, in order to respond to the Professional Learning Blog discussion prompts. At the end of the school year, I collected the Professional Learning Journals from five of the seven participants. Two of the seven, Ellen and Ed, did not return the journals, nor did they participate in the blog discussions. They explained that they were very busy creating professional learning opportunities for other teachers, and that most of that activity would take place over the summer. It was a large-scale project, and the preparation for it was intense; yet they still wanted to participate in the interview process as much as possible.

As I looked through the Professional Learning Journals that the five participants returned, I noticed that some participants highlighted only a few quotes or wrote in the margins, whereas both Mary and Laura used the Reflective Note Sheet. Unfortunately, Mary used a highlighter to write many of her thoughts within the margins of the article, and the photocopier did not recognize these markings. Therefore, I decided that whenever there was a highlighted marking, either of a quote, or a participant comment, I needed to use a dark fine pen to bracket those quotes or record the comments on the pages of the journal. This process also helped me review and familiarize myself with the data before the coding process began. I then scanned the pages that contained participant highlights or comments, and saved these files as PDFs, later to be coded and analyzed.

The Professional Learning Discussion Board

I used Edublog.org® as a forum in lieu of more common educational forums for several reasons. First, other than being affordable to maintain as the administrator, it

allowed me to set up password-protected accounts for each of my participants. Additionally, as the site coordinator, I found the site simple to create through the provided themes, and easy-to-set strict privacy settings to both the participant accounts and the blog itself. I invited the participants in the study into the group without making the participant discussions available to public viewers. The site, the content, and the postings of the participants were confidential and password protected. I assigned each participant a pseudonym and used these pseudonyms to create usernames for the blogging interface. Therefore, when the participants made comments or questions within the online forum, other users would see the pseudonyms. In this manner, the identities of the participants were kept confidential as each of the participants responded to prompts, interacted with other participants through discussions, and read the responses of other participants.

Between the participants' interviews and June 8th, they worked at their own pace to read and reflect upon the articles in the professional learning journals. Then, they responded to the discussion prompts on the blog that related to their readings. I developed one reflective prompt for each of the following topics: Collaborative practices, autonomy verses mandated collaboration, Mathematical knowledge for teaching (MKT), Good professional learning experiences, Bad professional learning experiences, and Evaluating professional learning experiences. Figure 3 provides an example of the participants' view of the blog.

I included other media as sources for reflective prompts on the site. For example, The Welcome Page also introduced a video of an educational researcher speaking about how to better prepare new teachers to become effective mathematics teachers. For this

Figure 3. The Professional Learning Discussion Board

video, I asked the participants to comment about what they thought it would take to promote effective teaching, and to discuss whether they agreed or disagreed with the researcher. In June, after following up with Ellen and Ed and giving them additional opportunities to participate in the blog, I compiled all of the participants' blog responses within a single word processing document to be coded for later analysis.

Other Data

Additional documents. I gathered additional documents related to school or school system-provided professional learning opportunities. Although I was primarily interested in participants from the field of secondary mathematics, I collected documentation of school-wide formal professional learning initiatives that were either voluntary or mandatory (i.e., peer-coaching programs, junior advisement training, and technology workshops). I recorded the schools' mission statements because they provided insight regarding the learning goals for both teachers and students within the

particular site. I utilized some of these documents as starting points for follow-up interviews.

During the interview process, some of the participants offered additional documents that related to their philosophies of mathematics, activities that they used in or websites that they use for professional learning. I included these sources only when I felt that they represented a participant's voice. For example, with Ellen's survey, she wrote in "Obey Poyla's Ten Commandments." I noticed that she also had these "Commandments" posted in her classroom. She provided me a copy of the commandments, with her amendments to each commandment written in blue, during the interview. I found this particular document useful as it provided additional insights about Ellen's philosophy of education. She also provided worksheets that she used in class to help students solve mathematical problems. I did not include other documents, such as worksheets and class activities, unless they specifically added a new perspective or idea that was not present during the interview.

Additional pictures. I took photographs at each site to better understand how each learning community documented and celebrated students' and teachers' successes. The photographs I took included trophies, plaques, mission statements, mottos, artwork, work spaces, and classrooms. Although I noticed some differences between the sites, the most significant factors of the school structures were included within the participants' photos.

Following up with participants. As the participants were responding to blog prompts and reading the Professional Learning Journals, I transcribed, organized, and analyzed the data. During the data analysis process, I kept track of unanswered questions

and gaps within the data. I emailed the participants or conducted one final interview with them during the following school year. Ultimately, this process allowed me to collect additional, clarifying information about their previous responses, and to get feedback from the participants while they were in close proximity to professional learning opportunities during pre-planning. Communications via email and follow-up interviews provided the participants additional experiences upon which to reflect and describe how they approached or participated in these learning opportunities. In addition to member-checking (Creswell, 2009; Merriam, 2009; Yin, 2009) the data and my presentation of their cases, I asked extension questions about whether their circumstances or professional goals had changed since the study. I asked each participant for clarifying information regarding their case and conducted a final interview with each participant to discuss the write-up of his or her case. I recorded the participants' feedback with field notes and/or summarized and reflected about our discussion moments after the discussion took place. I then transcribed these audio-recordings into a word processing document. These reflections after the interviews were regarded as memos that later aided in the data analysis process.

After all the data were collected, many of the participants still reached out to me for professional advice. For example, one participant needed help using some technology for a summer school class she was teaching. Another asked for my help at a summer workshop that she was developing. Additionally, the fact that I coached Math Team also built rapport with a couple of my participants, as they also worked with their Math Team. Therefore, long after the data collection process was over, I still had access to all the participants and was able to contact them throughout the data analysis process.

My non-judgmental positioning as the observer of their comments and behaviors equipped me to guide questions during the interview process into productive avenues of reflective responses. The interview techniques used in this process were informed by Merriam (2009), Yin (2009) and Creswell (2009). When participants were unresponsive to emails, I made an appointment to speak with them personally to verify and clarify that findings were emerging from my study. For instance, I conducted a follow-up interview with Betty to verify that she believed that freshman students found it difficult to understand applications of mathematics. I also asked Betty why she sought professional learning because she did not address her rationale for learning during the initial interview. It should be noted that some professional developers promote the use of reflective strategies within professional learning experiences (McNaught, 2007); however, the purpose of reflection was not used as a professional learning experience in and of itself. In this study, reflective responses and reflective behavior were necessitated by the need to collect rich, thick, and descriptive data about professional learning through the eyes of the participants (Merriam, 2009; Stake 1995; Yin, 2009). Thus, the participants' reflectivity aided the data collection process, and was not the subject of the study. The participants' perspectives remained the primary focus of exploration.

Scholarly literature. Due to the iterative nature (Lunenberg & Irby, 2008; Merriam, 2009; Stake, 1995) of the data collection and analysis, I constantly referred to the literature as themes emerged from the data. A few times, the review of the literature in light of emerging themes informed the questions posed for the participants through the online discussion board.

Memos. I recorded memos of my thoughts on a digital voice recorder shortly after conducting interviews, reading the discussion boards, or evaluating the data analysis process. I found the memos to be helpful data resources during the data analysis process because the memos helped me to bracket my position and voice as well as maintain a non-judgmental role with my participants. Additionally, memos became a vital aspect of my data analysis process as I began to form network views, find gaps in my data, organize and merge codes, and ultimately finding emerging themes within my data (Table 2). For example, I reflected on the "buy-in" code in one memo noting my thoughts.

> Teachers need internal buy-in and contextual buy in. They have to convince themselves that some educational venture is worth their time, energy, and resources, after they convince themselves that they can do it to begin with. This type of justification is critical to the learning process. It is the check-and-balance system for the teacher. How the teacher INTERPRETS the context (ie. philosophy of education, self-efficacy, and context) indicates to what extent they can and will take risks when learning something new.

I relied on these memos throughout the analysis process to help me maintain an honest position as a researcher, but to record my own thoughts as the data analysis process evolved.

Data Analysis Plan

Demographic data about the participants were analyzed using descriptive statistics. WinStep®, an Item Response Theory software program, was used to statistically analyze the participant responses to the multiple choice questions on the survey instrument in order to determine individual similarities and differences between

Table 2
Summary of Collected Data

	Site 1 Participants			Site 2 Participants			
Data Source	Betty	Mary	Lucy	Helen	Laura	Ed	Ellen
Survey Completed (Yes or No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Photographs							
# Discussed	5	8	5	4	8	13	7
# Not Discussed	4	0	0	0	0	5	2
Interview (min.)	46	49	42	145	107	117	151
Professional Learning Journal and Blog	1	57	3	6	63	N/A	N/A
# of Highlighted Quotes	0	6	1	0	9	N/A	N/A
# of Completed Reflective Note Sheets	7	6	7	6	4	N/A	N/A
# of Blog Responses							
Additional Data							
Follow-Up Interview (min.)	25	30	20	40	20	15	15
# of Participant Emails	5	7	11	15	1	0	1
Five Year Plan Received (Yes or No)	Yes	Yes	Yes	No	No	No	No
# of Additional Documents Provided by Participant	0	0	0	1	0	0	4

the respondents' conceptions of the nature of mathematics, learning mathematics, and teaching mathematics. I utilized ATLAS.ti®, a qualitative analysis software program, to both manage and organize my data, code my data, and to develop categories and themes.

I used *open-coding* to analyze the open-ended items on the initial survey. Open-coding (Merriam, 2009) is a coding technique by which I remained "open to anything possible" (p. 178) within the data while recording my thoughts, the participants' words, or literature related concepts within the data. Then, I used *axial coding* (Corbin & Strauss, 2007; Merriam, 2009) to group open codes after interpreting and reflecting about the relationships among the open codes. The axial codes that I developed from these free-response questions also informed an initial coding list that I used during my first pass through on subsequent data collected through interviews. From this initial

qualitative analysis of the teachers' responses on the free-response items, I selected a criterion sample of participants to deliberately garner mixed perspectives about professional learning. The participants were ultimately chosen based upon: (1) how long they expected to teach after this school year; (2) their philosophy of teacher-centered verses student-centered learning; and (3) their responses to the open-ended professional learning items. I ultimately chose a sample that varied greatly across each of these criteria. Fortunately, the differences among the participants' perspectives and variations of the years of experience between participants resulted in lively and engaging interviews. Vastly different responses within the survey instrument also allowed me to tailor questions during the semi-structured interviews with the participants to glean thick, rich descriptions of the participants' beliefs about professional learning. Once the process of gathering data through interviews and the discussion boards began, the more rigorous qualitative analysis process ensued.

Throughout the study, I memoed my own thoughts and reflections, and I strategically used ATLAS.ti® (Saldaña, 2009) to code the photos, memos, reflections, interviews, and digital responses (Corbin & Strauss, 2008; Creswell, 1998; Merriam, 2009). This dynamic program, designed specifically for qualitative research, allowed me to memo my thoughts, highlight quotes for analysis, and import various primary documents (including word-processing documents, digital copies of photographs, articles, interview transcriptions and scanned documents). I used open-coding, axial coding, and systematic coding progressively (Corbin & Strauss, 2008; Creswell 1998) in order to mine the data (Merriam, 2009) and reduce the data down to the most meaningful components.

As I transcribed and proofread my data for accuracy, I began to make notes of categorical schemes by which to organize my data (Corbin & Strauss, 2008). During my first pass through the data, I highlighted quotes from each participant that represented some aspect of their beliefs about professional learning or the process of professional learning. Because I had seven participants, I would circularly revisit previous data to determine if I missed quotes by focusing on the unmarked interview quotes within the ATLAS.ti transcript. When I completed this process of finding quotes, I created a network view of each participant's quotes. As I reflected on the perspectives and trends within each of the participants' quotes, I memoed within ATLAS.ti's comment feature to record my rich descriptions of the participants, and important codes that could be salient to their data. Figure 4 provides one such example in the analysis of Helen. I organized these quotes into piles to determine relevant codes.

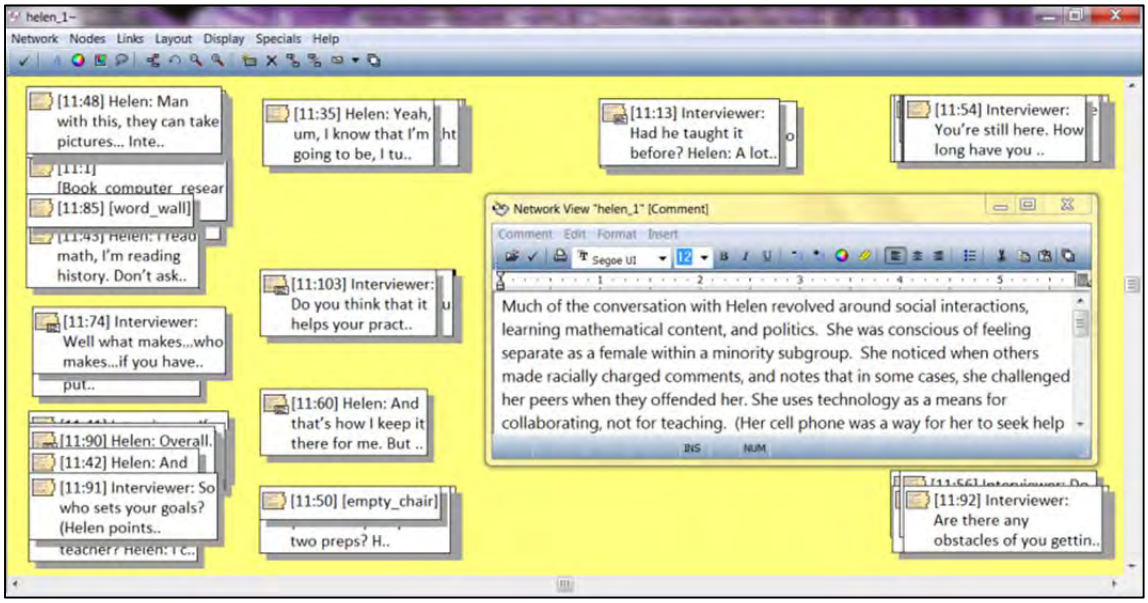

Figure 4. Helen's Network View of Grouped Quotes

After I made a network view for each of the participants, I developed a code list to use on my second pass through of the data. The initial code set developed from the process can be found in Table 3.

Table 3
Initial Code Set of 100 Codes from Analyzing Seven Interviews, Participant Photographs, and Participant Blog Responses

Keyword Category
"I can," "I can't," "Lowest common denominator," "My ideal PL would be...," "My school is" "Students can," "Students can't," "The ideal mathematics teacher must...," "They don't know me...," Academically focused, Accommodating students, Age, Anger, Applications_MATH, Assimilation, Authority, Ceiling on success, Change, Classroom Management, coaching, Collaboration, Common Planning, Community, Compared to Other Schools, Competitive, Confidence, Conflict with others, Content, Contextual, Cultural Context, Cultural differences, Differentiated Instruction, Effectiveness, Engagement, Exhaustion, Expectations, Experience, Expert teachers, Fear, Feeling valued, Flexibility, Floating teacher, Forever Learner, Graduate school, handouts, High Achievement, High stress, High-expectations, High Performing, Humility, Lunchtime, Mathematical literacy, MKO, Modeling for students, Money, Motivation, Motivational/Inspirational Speaker, My children, Observing Others, Oppression, Organization, Parents, Pedagogy, Personal Investment, Personal Stress, Personality, PL - Content focused PL _ desired, PL _ Formal, PL _ Individual_independent, PL _ Informal, PL _ not desired PL vs PD, PL_Goals, Planning, PLUs, Professionalism, Q:How do teachers evaluate the success of their own learning?, Rebel or speaks out., Reflection, Relevance, Reputation, Retiring, Teachers, Risk, School structure – facilities, Student levels, Students learning math, Teachers learning to teach mathematically, Teaching_team, Technology, testing, Time, Time management,Toughest part of teaching math, Training, Trust, Useful, Views of MATH Voice, Wisdom

As my focus narrowed, I collapsed redundant codes, developed descriptive categories, and then moved to the selective coding process (Corbin & Strauss, 2008 ; Creswell, 1998) in order to re-visit the data with a fresh perspective to determine whether the emerging themes were consistently present across multiple data sources. During the second pass through the data, I began to see a need for structural codes. Saldaña (2009) suggested that structural codes or question-based codes, provide an indexing device for larger data sets that include interview transcripts, field notes, and open-ended survey responses. Some of the structural codes that I included and utilized are provided in

Table 4
Sample of 20 Structural Codes Used during the Second Pass Through of the Data Among a Total of 52 Structural Codes

Structural Codes
Q:With whom do teachers learn?
Q:How do teachers learn?
Play vs Work (Dewey, 1933)
Experience_as_a_student(Dewey, 1933)
ideo_progressive_educator(Ernest, 1994)
ideo_industrial_trainer(Ernest, 1994)
DL_knowledge_insider(Spillane, 2006)
DL_knowledge_curricular(Spillane, 2006)
Capital_HUMAN_(Spillane, 2006)
Capital_CUTURAL(Spillane, 2006)
K&M_Personal_Lives(Katzenmeyer and Moller, 2001)
K&M_Career Stages (Katzenmeyer and Moller, 2001)
CSFN_Reflection_(Cooney,Shealy,Fennema,Nelson 1997)
CSFN_Adjusting_to_change_(Cooney,Shealy,Fennema,Nelson 1997)
CSFN_self_oriented_with_authority(Cooney,Shealy,Fennema,Nelson 1997)
GTCB_WWK_ANGER_(Goldberger, Tarule, Clinchy, and Belenky, 1996_HURTADO)
GTCB_Connected_knowing_and_teaching(Goldberger, Tarule, Clinchy, and Belenky, 1996)
GTCB_Development_of_doing_(Goldberger, Tarule, Clinchy, and Belenky, 1996)
GTCB_Voice_(Goldberger, Tarule, Clinchy, and Belenky, 1996)
GTCB_Silence_and_outspokenness_(Goldberger, Tarule, Clinchy, and Belenky, 1996_HURTADO)

Using a combination of structural codes, descriptive codes, such as “enjoyment,” or “stress,” and process codes (Saldaña, 2009) like “Modeling for students,” “reading,” or “taking risks outside of classroom,” my code list became over 300 codes long. I collapsed instances in which two or more codes were serving redundant purposes. For example, I merged “to elaborate on PL...” with the code “PL vs PD” because I felt that both of the codes identified data in which the participant was describing professional learning. Once the code list was reduced to 286 codes, I used the network view (and spin-off views), in order to arrange my codes to look for code families, categories, and themes. Part of this network view can be found in Figure 5.

I also used the ATLAS.ti co-occurrence tool to compare how many times I used each code between each of the participants. Such a comparison allowed me to find differences and similarities among all the participants with respect to philosophy of education or individual learning processes. The co-occurrence table tool produces a series of selected codes by rows and columns, and populates the matrix of cells with the number of times the column code was shared with the row code. For example, in the column "Betty," and the row "Authority," the co-occurrence table indicates that these codes were used in the same quote 23 times. I created and exported this table (Table 5) into a digital spreadsheet through which I was able to determine the most frequently occurring codes

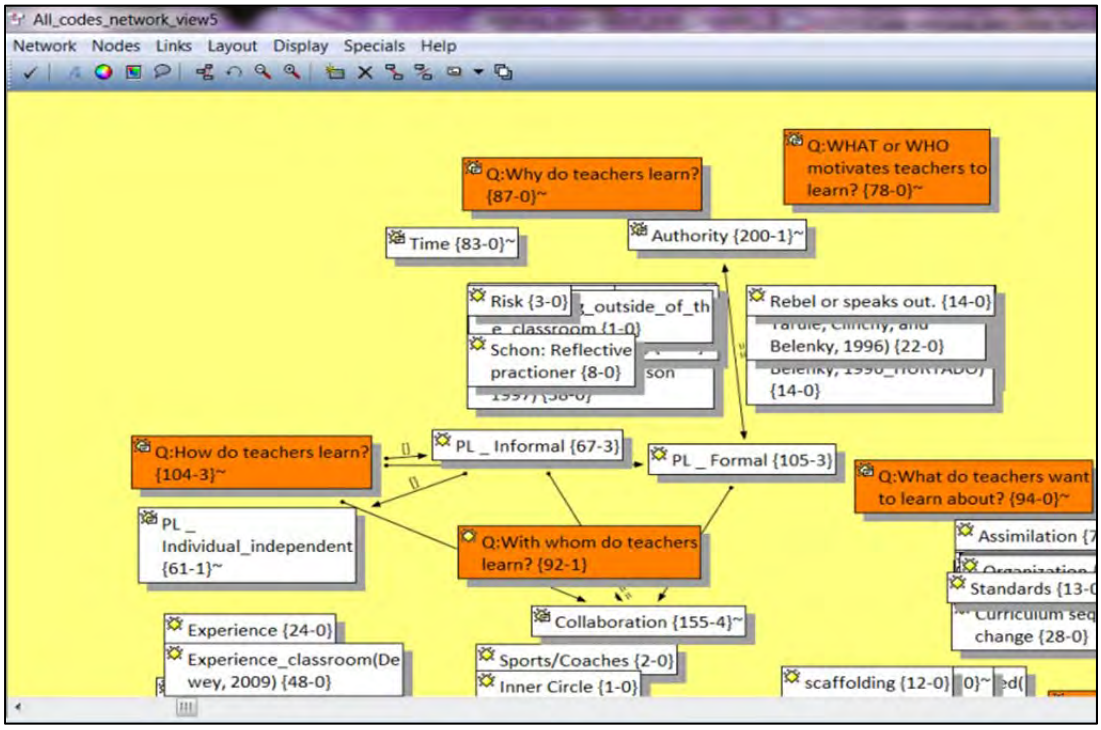

Figure 5. A Network View of the Organization of Codes

per participant, and determine codes within which some of the participants had a high number of co-occurrences while the other participants had little to no occurrences. Using

Table 5, different learning process patterns emerged for each participant, and differences among the participants became more apparent.

Table 5
A Co-Occurrence Table for Professional Learning Belief Codes

Code	Betty	Mary	Helen	Lucy	Laura	Ed	Ellen
CSFN_self_oriented_with_authority (Cooney,Shealy,Fenema,Nelson 1997)	3	11	16	4	8	9	14
CSFN_Viability_ (Cooney,Shealy,Fenema,Nelson 1997)	0	0	0	2	4	1	0
GTCB_Connected_knowing_and_teaching (Goldberger, Tarule, Clinchy, and Belenky, 1996)	0	11	18	7	18	0	31
GTCB_Development_in_WWK (Goldberger, Tarule, Clinchy, and Belenky, 1996)	0	28	6	4	25	0	19
GTCB_Development_of_doing_ (Goldberger, Tarule, Clinchy, and Belenky, 1996)	0	9	12	3	14	0	10
GTCB_Silence_and_outspokenness_ (Goldberger, Tarule, Clinchy, and Belenky, 1996_HURTADO)	4	3	2	0	8	0	0
GTCB_Voice_(Goldberger, Tarule, Clinchy, and Belenky, 1996)	4	8	23	4	3	0	0
GTCB_Withdrawal_(Goldberger, Tarule, Clinchy, and Belenky, 1996_HURTADO)	0	0	3	0	0	0	0
GTCB_WWK_ANGER_(Goldberger, Tarule, Clinchy, and Belenky, 1996_HURTADO)	0	0	39	0	0	0	0
GTCB_WWK_Multiple_Identities_(Goldberger, Tarule, Clinchy, and Belenky, 1996_HURTADO)	0	0	36	0	0	0	0
GTCB_WWK_Multiple_lenguas_(Goldberger, Tarule, Clinchy, and Belenky, 1996HURTADO)	0	0	3	0	0	0	0
GTCB_WWK_Shifting_Consciousness((Goldberger, Tarule, Clinchy, and Belenky, 1996_HURTADO)	0	0	37	0	0	0	0
GTCB_WWK_Subjugated_knowledge(Goldberger, Tarule, Clinchy, and Belenky, 1996_HURTADO)	0	0	38	0	0	0	0
ideo_industrial_trainer(Ernest, 1994)	6	3	15	0	0	1	0
ideo_old_humanist(Ernest, 1994)	1	2	22	6	4	0	8
ideo_progressive_educator(Ernest, 1994)	0	0	2	0	2	24	75
ideo_public_educator(Ernest, 1994)	0	1	0	0	1	0	0
ideo_technological_pragmastist(Ernest, 1994)	1	21	3	4	1	1	0
Perry's stages of intellectual development	0	0	0	0	0	25	0
PL_Freedom_vs_Required(Belenky et.al. 1986)	6	23	8	14	19	1	14
Play vs Work (Dewey, 2009)	0	0	0	3	0	0	26
Q:What are the philosophies teachers have about learning?	0	21	9	12	34	15	49
Reflection	5	17	7	33	18	7	47

Finally, once all of my data had been coded, grouped into categories, and identified through emerging themes (Corbin & Strauss, 2008; Merriam, 2009), I began the writing process to articulate the findings of my research. The data analysis process

was customized, and the specificity of the interview and discussion questions was narrowed and adapted as the study progressed. This process, described as either spiraling (Wiersma & Jurs, 2009) or funneling (Creswell, 1998), fostered my use of intuitive insight as the analysis process looped between data collection, data analysis, reading, and finding themes until saturation of the data had been accomplished (Creswell, 1998).

Even though I had a short timeframe to survey, conduct multiple interviews, and prompt discussions through the online forum, multiple data sources provided enough data to saturate my findings (Corbin & Strauss, 2008). I reached a point in which no new information or insights could be gleaned from mining the data (Corbin & Strauss, 2008). Additionally, I found that although I could no longer generate additional categories for my data, the categories and themes that I had developed were interrelated. These connections among the categories provided clear insight into my exploration of the participants' beliefs toward professional learning. When I reached this point of saturation (Corbin & Strauss., 2008), I stopped collecting data and moved on to the next phase of my research.

Ethical Issues

Creswell (2009) suggested that every researcher needs to anticipate and tend to any ethical issues that may occur. These issues can surface within any stage of the study, including but not limited to stating the research problem, purpose or questions, data collection or data analysis, and also reporting the findings and disseminating the research. In particular, the data collection process can be plagued with ethical issues if the researcher does not proactively anticipate or actively combat these problems. I protected the confidentiality of all the participants through the use of pseudonyms, by not using

personal or professional means to communicate with the participants online, and through the coding process by disassociating the actual names of the participants with the data.

All of the data will be destroyed within five years of the study. Participants could have made the choice to stop participating at any point during the study, and at that time, I would have deleted and erased any data gathered from such participants. Personal statements about the ownership of the data and how it will be destroyed was included in the participant consent form. Additionally, other than my dissertation committee, data were not shared with outside parties during the study; however, the participants were informed that any data used for future publications would not be linked to them with any identifying characteristics. Debriefing took place after each interview to member-check the data I had collected during previous phases of the study. Additionally, to increase the accuracy of the data interpretation process, I analyzed the data from all the participants across multiple sources. Each step followed guidelines provided by qualitative methodology literature (Creswell, 2009; Merriam, 2009).

Triangulation

Although time constraints do pose additional obstacles for the data analysis process, I promoted triangulation by using multiple data sources and by interpreting the data through multiple theory perspectives (Creswell, 1998; Patton, 1980; Wolcott, 2001; Yin, 2009). The use of multiple sources bolstered the credibility of my findings. Clear, concise themes emerged from authentic data, which I took great care in preserving throughout the study (Creswell, 1998; Patton, 1980). Triangulation does not occur just because one has multiple sources of data (Yin, 2009); it is when the emerging facts or themes of the case study have been supported and corroborated by multiple sources that

triangulation has actually been achieved. Therefore, with a plethora of data sources used within this study (photographs, interviews, participant reflections, and additional documentation), achieving the triangulation of my themes through various sources was a manageable and attainable goal.

Working with my methodologist and considering the literature on professional learning resulted in my development of a semi-structured interview protocol that helped elicit responses regarding how these participants conceptualized professional learning and why they do or do not pursue it. After determining whether each participant had at least one recent professional learning experience, the protocol probed the participants as to how they assessed their learning in light of professional learning experiences. These teachers were already situated within the contexts of high performing schools. However, if their students are already high-achievers, how do teachers measure their own success using professional learning strategies? Do they measure mathematical success in different ways? Do they seek external approval or internal satisfaction? Findings could answer some of these questions and illuminate professional learning in a new, dynamic and descriptive way.

The internal validity (Merriam, 2009; Yin, 2009), or the credibility of my findings, was promoted through the member-check process (Creswell, 1998; Stake, 1995) and through triangulation of emerging themes through multiple data sources (Merriam, 2009; Patton, 1980; Stake, 1995). Reliability was also strengthened through the clear documentation of the theoretical underpinnings, research purpose, and data collection process, and a transparent audit trail so that other researchers could replicate this study within different contexts (Creswell, 2009). I used a case study database (Yin, 2009)

during the data analysis process to organize my data and findings by participants. Finally, the external validity, the degree to which my findings could be transferable to other contexts, was enhanced by the rich description of my data and findings (Merriam, 2009; Wiesma & Jurs, 2009; Yin, 2009).

Trustworthiness

Trustworthiness (Merriam, 2009) of the study was enhanced through a well-documented paper-trail for potential auditing processes and participant checks of the transcription and online reflections (Creswell, 1998; Stake, 1995) to ensure that the data that I captured represented the true and authentic perspectives of the participants. Further, my dissertation committee served as a sounding board for advice, feedback, and supervision of the process as it progressed.

My trustworthiness (Merriam, 2009) as the principle researcher heavily relies upon the ethical manner by which I conducted the study, recorded and analyzed data, and recorded my findings. The dissertation process was guided by my dissertation committee, which helped to serve as my check-and-balance system throughout each phase of the study. The guidance and oversight that the committee provided was an invaluable resource to acquiring study trustworthiness. This was also strengthened through the transparency of the process, triangulation of data, and through the rich descriptions of the detail in my data.

An investigator must maintain a certain skill set during the data collection process (Yin, 2009). Indeed, during interviews, I asked open-ended, thought-provoking questions to elicit the most reflective, descriptive explanations possible. My listening skills were enhanced through the use of a digital audio recorder. The use of a digital recorder

allowed me to hear details of the interview that I could have missed during the interview. These details, if salient to my research, were topics of follow-up questions during the final stages of my data collection process. These recordings helped me to not only make sure I gathered the correct data, but also allowed me to hear the words of my participants as I bracketed my own biases and perspectives. Taking a non-threatening stance, I worked with my participants to gain trust, be sensitive of emerging emotions and concerns, and help them feel at ease during the interview process.

CHAPTER 4: INTRODUCTION TO PROFESSIONAL LEARNING PROFILE, SETTING, AND PARTICIPANTS

Setting

The School District

Sites 1 and 2 belong to a school district that serves over 100,000 students. Within this district, over 15 high schools serve unique learning communities that differ in socio-economic backgrounds, student body demographics, and transient rates. On average, the school district demographics of the student body are Caucasian (45%), African-American (31%), Hispanic (17%), Asian (5%), and Multi-Racial (3%). Nearly 45% of the students in the district qualify for Free/Reduced Lunch, and the transiency rate is 24%. Yet, schools within the school district vary greatly from this district average. For example, one high school within the school district has a student body of around 1,700 students. The demographic make-up of the student body is African-American (39%), Hispanic (49%), Caucasian (7%), Asian (2%), and Multi-Racial (3%), in which over 80% of the students are eligible for discounted or free lunch. In contrast, the student bodies of Sites 1 and 2 are predominantly Caucasian (over 70% at each site), with a considerably smaller proportion of students who qualify for free and reduced lunch (Site 1 (5%) and Site 2 (14%).

Why are these differences within the school district important to the present study? Each of the participants spoke of their needs or their educational community with respect to *other* schools in the school district. Participants described their school in terms

of how their school was different from other schools in the district, and also how their professional learning needs were different than teachers at other schools within their district. As teachers discussed learning with other teachers within their school district, these differences became more clearly defined as they either assumed distinctions or experienced them through teaching in other schools themselves.

Site Distinctions

Although both of the sites for the study shared similarities in academic performance, differences existed regarding administrative involvement, collaboration opportunities, and the mathematics departments themselves. These differences were illuminated by the participant interviews and provide a context for the interaction with other teachers and administrators mentioned by the participants during the interviews. Additionally, collaborative opportunities provided and evaluated by the schools' administrations also served as a backdrop for the participants' desires for planning time allocated for professional learning.

Administration and governance. The governance systems at Sites 1 and 2 were quite different. Site 1 maintained a school governance system of several committees, such as Attendance, Student Climate, or Curriculum and Instruction, in which representatives participated from each department, as well as administrators, parents, and students. Changes within the school were approved after a council comprised of students, parents, community members, administrators, and teachers voted on the issue. However, participants at Site 2 expressed that their school practiced a more traditional approach to administration and governance. Changes within the school were primarily decided by administrators after consulting with department chairs. These differences also influenced

the initiatives in professional learning that took place within the school, as well as the ways these initiatives were annually evaluated for effectiveness.

Time to work with peers. Both sites implemented different systems to allow teachers to purposefully collaborate. Site 1 actively supported a teacher Peer Coaching program, through which teachers who were trained in peer coaching could collaborate with one or more teachers from within or outside of their department. These teachers went through coaching cycles with a peer in which they gave and received coaching. During the coaching process, teachers would set professional learning goals and develop data collection instruments to be used when their peers observed them teaching. Coaches recorded data relevant to the teachers' developed learning goals. At the end of the process, each teacher wrote a reflection of their goals, process, and thoughts to be submitted to the administrators. The administrators then conferred with the peer coaching team to discuss their findings. Those involved in peer coaching had to apply through an application process to participate, and administrators chose which applicants would participate.

Although the participants at Site 2 discussed observing teachers in and out of their department, no formal peer coaching system was in place. However, unlike Site 1, Site 2 teachers noted that their administrators provided a common planning period for each department. Specifically, administrators deliberately scheduled teachers from the same department to have a common planning period. Some of the participants discussed how this planning period was used, misused, or ignored by their peers. One participant in particular noted that administrators would "stop by" once a month to check their progress.

Relationships within each department. It is also important to keep in mind the relationships among the participants. Betty, Lucy, and Mary all taught at Site 1. All three taught 9th grade mathematics, and work together occasionally to plan the sequencing of the units, the assessments, or the activities for the course. Unlike Betty and Mary, Lucy also taught a brand new senior course with other members in the department. As part of a departmental policy, teachers within like subject areas were expected to be in "lock-step" with each other in terms of pacing, assignments, and assessments. Although they were allowed to vary with respect to how they teach mathematics, what they taught and when they taught it was expected to be uniform. As with Site 2, teachers at Site 1 were not expected to turn in lesson plans to their administrators.

Helen, Ed, Ellen, and Laura all taught at Site 2. Ed was the department chair, taught calculus, and collaborated with Laura, who also taught calculus. Ellen, who taught an Honors PreCalculus course, also worked closely with Ed for a couple reasons. First, Ellen vertically collaborated with Ed to ensure that her Honors PreCalculus students were aptly prepared for his calculus class the following year. Second, Ed and Ellen are married (I asked Ed and Ellen for permission to disclose this identifying factor within the study, and they agreed to allow me include this characteristic of their relationship). As I decided whether to include this unique, identifying factor about Ed and Ellen, I determined that their relationship was far too important to omit. As I analyzed their interviews and their stances on education, I realized that their perspectives, experiences, and learning styles were intertwined. Because they are married and have no children together, they had spent a great deal of time together at home, at work, and during professional learning activities. Although Helen did not share any common course with the other participants at her site,

she expressed that she sought out Ellen and Ed for professional guidance. Helen was originally encouraged by both Ed and Ellen to come teach at Site 2. Unlike Site 1's mathematics department, teaching teams are not expected to give the exact same assessments or follow the same pacing as other like subject area teachers. Teachers at Site 2 collaborated and may still have chosen to work independently from one another regardless of the size of their subject-area team. This increased isolation was evident as teachers from Site 2 spoke of their collaborative relationships with their peers.

Participant Learning Profiles Overview

Ultimately, the purpose of this study was to investigate the professional learning processes of mathematics teachers in high performing schools from the perspectives of teachers themselves. As part of my criterion sample, I chose the participants because they espoused different perspectives of teaching and learning mathematics through the initial survey containing both multiple-choice and free-response items. I collected a variety of additional data through Photo Elicitation Interviews, blog responses, photographs, and Professional Learning Journal responses to anchor their unique perspectives. Each participant recounted how they learned independently, with others, or because of the requirement of others. The Photo Elicitation Interviews with each participant followed a similar pattern. First, the participants spoke about their photographs and their correlation to professional learning. Then each participant discussed their professional goals, perceptions of expert mathematics teachers, and their learning processes. The participants revealed the sequence of their own learning through the resources they preferred, and discussed how they distinguished between professional learning and professional development. The participants described their favorite and least favorite learning

experiences and then detailed why the experiences were positive or negative. The later blog responses and professional learning journal reflections provided additional details to support these perspectives.

During the analysis process, I found commonalities and differences among the participants' perspectives on learning. The emerging themes will be discussed after the participants' *Professional Learning Profiles*. However, the participants' unique personalities, learning needs, and learning motivators emerged through their narratives of professional learning experiences. Thus, in addition to the pseudonym, I assigned a character name, such as Pioneer or Observer, to describe the learning lens through which the participant filtered his or her learning goals and experiences throughout the study. These learning lenses indicated the participant's underlying perspective, and the multiple data sources used within the study supported this perspective within each case. In the following participant profiles, I present the participants' background, learning goals, learning processes, and additional significant factors that motivated or deterred the learners' professional growth through their own words. Following the profiles, I detail the themes that emerged from the data analysis process and discuss how the participants' views agreed or diverged along these topics.

CHAPTER 5: BETTY'S PROFESSIONAL LEARNING PROFILE

Background

Betty taught 9th grade and 10th grade mathematics at Site 1. Betty, a Caucasian female in her late fifties, had never been married and had no children. She entered teaching after working for 23 years for a computer company in the business world. She did not have any additional teaching endorsements; however, she did have a Bachelor of Arts degree in Mathematics. During the time of the study, she had been teaching for 13 years, and she planned to retire from teaching within three years.

Photographs

Although Betty was asked *not* to photograph people or identifying factors of her school, Figure 6 was the only photograph among nearly 10 photographs which contained no human subjects. This photograph captures copiers and two vinyl-covered chairs around the mathematics department's lunch table. Her other photographs included students gathered around a desk using a calculator; cheerleaders working together to make Pep Rally signs for an upcoming basketball game; and teachers talking together at lunch, herself holding up a protractor, and two teachers standing together at the front of a classroom looking at a common document. During the interview, Betty explained that she wanted to capture the collaborative aspect of learning that was important to her.

> I think that most professional [learning] is interactive with your peers when you are planning. And it is generally not during a specific time period that you're learning the things that you need in your profession… You do much more of it as you go and as you grab people when they're available... I think it's an ongoing process and not something you can schedule. (Interview)

Figure 6. Betty's Photograph of the Department Lunch Room

During this professional learning time, she explained that she worked with her colleagues to interpret her state's new curriculum and planned out summer packets for their students to help them prepare for the following school-year. These moments of collaboration generally took place during lunch or after school.

Betty also valued tangible resources and organization. For example, she photographed one teacher who floated into other classrooms because she did not have a classroom of her own. Floating teachers do not have a classroom of their own and must teach their classes in various other classrooms throughout the day. Teachers who float use vacant classrooms as they become available when the teacher who uses the classroom throughout the day has a lunch or planning period. Betty's photograph included a smiling, young, new teacher to the department holding onto a tall rolling cart. The cart, looking much like a three-shelf cabinet on wheels, held the teacher's laptop, a three-ring binder labeled "PreCalculus," a red hanging drape of pockets containing multiple folders, and numerous baskets containing pens, markers, and papers. Betty explained during the interview:

> She has to move from room to room, and I remember when I did that and how difficult time management is… I think it deterred from my growth as a teacher to float because you don't have your things. You can't set things up. You can't set up a warm-up ahead of time… [Y]ou can figure out ways to overcome the disadvantages, but... I think it's ten times harder not to have your *stuff*. It's bad enough to be organized in your classroom. I think that how to be organized, how to organize all that we have to organize is very difficult. I think everyone has their own strategies, and… I think that sharing those strategies is important.

Although Betty's background included working for a technology-affiliated corporation, she explained that the technology she uses as a teacher made it more difficult to organize her files. The difficulties were especially pronounced due to her state's curriculum reform, which rearranged content areas per grade level and had various names for classes.

> If you're organizing your files and you open 'em and move 'em to a subjects, (I've done this, I've been trying to do this for years. I'll be retired before I get done. I don't know when I have duplicates.) So, you're filling up your hard drive because you can't really see what's there or without printing it and putting its title on it and then saying, "Oh yeah. Here have the same file, different title. I can delete this one." You wind up with too much, and it's hard to organize… You can't do that in an ever-changing environment, because you don't know ahead of time what it's been changed to. (Interview)

Betty equated professional learning to planning, and during that time she worked with her colleagues to develop supporting materials for the new 9th grade mathematics classes that were being implemented in her district. During the interview, Betty described the tiring process she experienced when re-creating materials for new mathematical courses.

Betty underscored that she prepared for her classes and the new curriculum by planning with others. Although the structure of her classroom was important to her, being

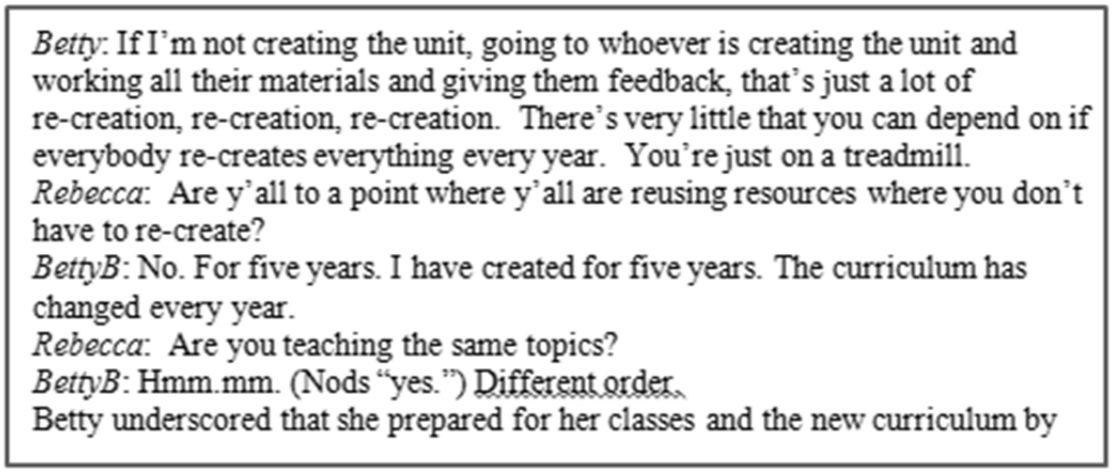
Betty: If I'm not creating the unit, going to whoever is creating the unit and working all their materials and giving them feedback, that's just a lot of re-creation, re-creation, re-creation. There's very little that you can depend on if everybody re-creates everything every year. You're just on a treadmill.
Rebecca: Are y'all to a point where y'all are reusing resources where you don't have to re-create?
BettyB: No. For five years. I have created for five years. The curriculum has changed every year.
Rebecca: Are you teaching the same topics?
BettyB: Hmm.mm. (Nods "yes.") Different order.
Betty underscored that she prepared for her classes and the new curriculum by

Figure 7. Transcript from Betty's Interview

able to adapt to a seemingly ever-changing curriculum was difficult for her. She struggled with both time management and organization as she felt she was constantly recreating the material for her classes each year. In order to adapt, she leaned most heavily on her peers who were teaching the same courses with her.

Perspective of Learning and Teaching Mathematics

After we discussed Betty's photographs during the interview, our conversation evolved to focus on teaching and learning. I was interested to see how Betty defined an expert mathematics teacher, whether she considered herself to be an expert mathematics teacher, and how this influenced her professional learning goals. Betty described expert mathematics teachers by the following:

> They are able to make up very good problems for tests and quizzes. They are very good at evaluating children at different levels and challenging them to those levels. Um. I think that they are generally people who can keep the kids engaged and interested. Not, not bored, but are actually trying to turn the kids into people who enjoy math, can look around and see math in the world and manages the classroom. (Interview)

Betty then pointed out that expert teachers are "able to teach everything in the curriculum" (Interview). When I asked her whether she considered herself to be an expert

mathematics teacher, she shook her head and stated, “No, because I can’t teach the higher-level classes. I’m too old.”

This portion of the interview revealed two important facts about Betty’s perspective of learning and teaching mathematics. First, although expert teachers should motivate students, they must also know “everything” (Interview). This idea of learning mathematics in its entirety was later supported by a story that she told about learning calculus as an undergraduate mathematics student.

> I didn’t like going to eight o’clock classes, and that freshman year I got to the end of the second semester, and luckily I went to a small private school. And I said to the guy, “What’s my average?” This was before the exam. He said, “You have the lowest average of anybody in here.” And I said, “Yeah. Guess I’ll major in Spanish.”… I told him if he gave me a C, I’d teach myself the calculus over the summer, and I would work every problem in the book. And he gave me the C, and that’s what I did. And so, in a lot of ways, that’s how, that’s how, if I had learned something, that’s how I do it. (Interview)

Betty’s bargaining chip to her professor to pass her mathematics class consisted of a commitment to learn mathematics through repetitively solving textbook problems. Therefore, she believed this method was effective as she pointed out that she not only learned through this method, but this method was also how she preferred to learn.

Second, Betty felt that a person’s age influenced what one could learn. Here, she pointed out that she could not learn upper level mathematics classes because she was too old. Later in the interview, she pointed out that the age of her students influenced the degree to which they understand application problems. “It’s impossible to talk to ninth grader[s] about applications… They don’t *understand* the long-range implications of the math they learn at their age. They *can’t*.” When I asked Betty when the curriculum should introduce application problems, she flatly stated:

> Just don't do it! Do it as it applies. There's exposure that you can give to certain things. I can do temperature. It goes up. It goes down. And it goes into negative numbers, but there's, there's just not a lot of applications for ninth graders. They're just too *young*.

She went on to rationalize this perspective by asserting that because freshmen cannot drive and do not have banking accounts, they could not truly see the connection between the contrived real-world problems and mathematics. Due to this disconnect, Betty believed that the applications of mathematics should wait until they are more mathematically mature. Among all the participants, this perspective on age and ability to learning mathematics was unique to Betty. Developmentally, age was a factor that she could not control and limited what she and her students could learn about mathematics. As a result, when I asked her how she would learn a new topic, such as calculus, she pointed out that she would rather quit teaching than try to teach an upper level class. "I would resign. I really would. That's the honest truth. I wouldn't even try. No… Not at my age."

Ironically, Betty explained that her age also empowered her to have more career options, both within her previous career in corporate America and as a teacher. When her previous company made looming threats about layoffs, Betty spoke up. "So, finally, I said to them, 'Have a layoff. Lay me off. I don't care.' Somewhere I'll find a job. I've never not been able to find a job. I've never struggled to have a job or to find a job" (Interview). Having the luxury of being older, with the ability to retire, empowered Betty.

> I'm retired. I don't have to work. I'm lucky in that respect. If I want to quit, I can afford to quit, and there is… good and bad to that. It doesn't change your personality or your commitment. It just changes the fact… that you have options, so that other people cannot dictate—do not have influence over the outcomes. (Interview)

Therefore, in terms of learning, age can limit the ability of the learner; however, for Betty, age also gave her more power as it provided more financial options and career flexibility than those of other younger teachers.

Professional Goals

If Betty could choose the focus of her professional learning, she would choose to learn about planning or organization. She said that she was interested in "time management… different ways to be organized when you have to move around all the time. I think that's a useful type of structured professional learning" (Interview). She also desired to organize and understand the new curriculum by collaborating with her peers. She noted, however, that there just does not seem to be enough time for such collaboration.

Professionally, Betty wanted to retire within the next five years, and until that time, she hoped to continue to teach 9th and 10th grade mathematics. She felt confident in her ability to work with students who struggle to learn mathematics. During the subsequent school year, I followed up with Betty to see whether her professional goal had changed. She informed me that she was retiring. Why? "Because I could. The stress of the curriculum. I can't work fourteen hours a day. There wasn't any promise of it changing" (Interview).

However, she vaguely suggested that she would be back. Although she retired during the middle of school year, she was granted permission by her school's administration to return as a volunteer to cover the lunch duties of some of her colleagues. She remained connected to her school, visited her former students, and helped her friends. Volunteering for lunch duty allowed her to see the students she had left

behind and to give her colleagues planning time, which Betty felt was important. In addition to volunteering, she also became a substitute teacher, only working within the mathematics department. On days when she was not volunteering or substitute teaching, she occasionally visited her former mathematics department for lunch.

Motivation to Learn

During a follow-up interview, I asked Betty why teachers should learn. She explained her motivation for learning through her contrasting experiences in both her former career and her career as a teacher. Before she was a teacher, she described learning in other career settings.

> I learned technology programs because I had to know it for my job… Sometimes you have to learn something because it is a technical aspect of your job that you need to know to do your job: computer upgrades, software programs, and tools. (Interview)

Now, as a mathematics teacher, Betty pointed out that she did not feel she had much to learn from mathematics education classes. In terms of mathematical content, Betty retorted, “I’ve had math education classes and could teach that stuff to myself if I wanted to. I just didn’t want to” (Interview). For Betty, professional learning occurs when she is prompted to go to training. She specified that she had a lot of professional learning during her previous career, which was required.

> I’m a different than younger teachers. I took fifty-seven courses at [the corporate company] in twenty-three years. I took one course that was a twelve-week course… It was a lot of training… I was in a technical field, and I needed to know the technical—I had to know how the piece of equipment I was technically supporting, how it worked. (Interview)

When I asked her whether teachers needed training, she said that teachers should be able determine whether they need training, and if they could not, it should be pointed out to them by others.

> *Betty:* They should know whether they need training… [T]here are other people that also know what they need training in. And as a team, if there's weaknesses in the team, then that needs to be addressed.
> *Rebecca:* Who addresses it?
> *Betty:* Department head… Probably other team members.

During a follow-up interview, I asked her what or who motivated her to attend professional learning sessions. Betty replied, "I needed to use it for my job. Nobody told me what to do." However, she contradicted this sentiment when she stated that she learned "because it's required. Technically, it's part of your job. You would lose your job if you don't know how to use your SmartBoard. I learned technology programs because I had to know it for my job." (SmartBoards are interactive whiteboards that allow teachers to use touch detection to control and operate the personal computer as it is projected onto the flat-panel screen.) Overall, Betty's learning experiences were motivated by a need to either adapt to curriculum reform through collaborative planning with peers or by the need to learn technology. In particular, this need could be self-diagnosed or addressed by an outside party, like an administrator, department chair, or peer who requires such professional learning.

Methods of Learning

Betty described her learning experiences with respect to collaborating with her colleagues during planning and lunch, independent planning during her summer vacation, and by attending mandated professional learning sessions provided by her school district. When I asked her during the interview how she would prepare to teach a course like calculus for the first time, she quickly indicated that she would rather quit teaching than teach calculus. Then, I changed the hypothetical content area to Algebra 2, because this course was closer in content to the classes she currently taught. She then described how

she would prepare to teach the course. “I could do that, but I rely on my peers a lot. What would I do? I go through the book. I go to the curriculum. I go through whatever people have that I can look at to see what they’ve done in the past. Um. Learn it.” How does she learn it? She teaches herself the content through repetitive practice of mathematical problems. As previously described, Betty “taught herself” calculus by working out every problem in her class textbook. “If I had to learn something, that’s how I do it” (Interview).

Positive and Negative Learning Experiences

Betty described a couple of positive learning experiences, and they both included learning some aspect of technology. On the Professional Learning Blog, Betty indicated that one of her best learning experiences occurred during lunch time when a teacher suggested “the best way to teach transformations. She suggested using TI interactive, and my students have enjoyed the process ever since. I still use it today. The learning was done in an informal way.” During the interview, Betty also described that she enjoyed attending a mandatory technology workshop required through her school district. The school district required all of the educators in the district to exhibit technology literacy skills. Teachers who had taken technology integration classes within the previous five years could opt out. Ineligible to opt out, Betty was required to attend. The workshop consisted of eight sessions over the course of two months. “We learned Excel, PowerPoint, and Word. There was enough time spent on the programs to actually be able to use them and to apply them to classroom tools. We actually, I mean, we had *that* much time.” In both cases, she assessed her professional learning on the basis of whether she still used the strategies or whether she was “able to do it” (Interview). In other words,

Betty found the experience beneficial because she was able to acquire and use a new technological skill.

In contrast, the negative learning experiences that Betty discussed during the interview included being a floating teacher or attending professional learning sessions that did not seem relevant to her needs. Organizationally, she thought that not having her own classroom and having to float to other teachers' classroom was a detriment to her learning because she did not have her "things." The process made it more difficult for her to prepare and set-up for her classes ahead of time. Although she conceded that she could figure out ways to overcome the disadvantages of floating, she believed "it's ten times harder not to have your stuff" (Interview). Being able to plan ahead, either for the year, the unit, or by day, was important to Betty, and the experience of floating made her feel unprepared for her classes. She needed her own space.

Betty had a love-hate relationship with technology. Although she appreciated the technology workshops offered by her county, which aimed at helping her become more technologically literate, she also resented being forced to learn about technology that she was not going to use. For example, she pointed out during the interview that a one-hour Geometer's Sketchpad demo was a "waste of time" because she claimed the instructors "aren't doing anything I'm going to use." During the session offered off-site by her school district, the instructors did not allow her to sit down, develop products, or figure out "the things you can't do." Her complaint was not about the software program; it was about the method of delivery.

> Anything that we've done like that—ClassPad, SmartBoard—you watch someone else do something. Oh, it's great! It'll do all those things. Oh, that's great. You sit down there and do it, it will take you six hours to

> figure out how to do it, and then you don't have anyone to help you figure out what you *can't* do. (Interview)

These positive and negative experiences indicated that Betty desired structured learning environments that provided her enough time to become familiar with the program, use it, and figure out what she could and could not do with the program without additional guidance. At the point when she needed help, she wanted to be able to seek out a human resource to help her fill in those gaps.

Belief Systems

Betty believed that she participated in professional learning either because "someone tells you to learn something or because it is a technical aspect of your job" (Follow-up Interview). The types of learning experiences that she enjoyed typically included experiences such as attending mandated professional learning workshops during which she had enough time to learn and ask questions about using various software programs. Additionally, she preferred to work with her peers in order to plan structured units for her curriculum. In light of WWK (Belenky et al., 1986), Betty's perspective of learning resembled both received knowing and subjective knowing. In regards to why she pursued professional learning opportunities, she held a received knowing position, in which knowledge and authority are understood to exist outside of one's self. She consistently looked to other entities to tell her what to learn, when to learn it, or how to plan. During the interview, she pointed out that teachers "should know whether they need training… There are other people who also know what they need training in, and as a team, if there's weaknesses in the team, then that needs to be addressed [by the] department head." Therefore, she believed that if teachers did not address their professional weaknesses, other teachers and even the department head should address

them directly. She also felt that other authority figures dictate her professional learning experiences. “My guess is that professional learning is determined by administration and usually the county central office. It is managed by the state due to required PLU credits” (Blog Entry). Through these examples, Betty acknowledged her voice as a learner, yet she also waits for authority figures to tell her what to teach, how to plan, or what and when to professionally learn.

However, Betty also demonstrated characteristics of learning through subjective knowing. Belenky et al. (1986) pointed out women who transition from received knowing to subjective knowing “shift from silence or conformity to external definitions of truth into subjectivism” (p. 54). Subjective knowers have shifted their view of authority from an external figure who “binds or directs” (Belenky et al., 1986, p. 54) to acknowledging the internal authority within oneself. Betty’s description of her interactions with her colleagues during a planning session illustrated that she recognized and vocalized her own voice and authority, yet she expressed that she was sometimes ignored or misunderstood. For example, Betty alluded to an incident in which her department chair mistakenly thought that Betty was the source of problems within her teaching team. Betty pointed out that her department chair’s perspective of her changed as they worked together throughout the school year. “I think that she felt that it was *me* as well as maybe some other things… and I think that she gained some respect for me, so through this process. So, I think it’s different now… I think that the problems got realized” (Interview). In this case, she demonstrated a belief that her department chair, an authority figure, could be wrong.

It is important to Betty that other teachers listen to her voice and respect her professional perspective. During the interview, Betty described attending a professional learning session that took place at the beginning of the school year. She expected to plan for the 10th grade mathematics course, yet when she arrived, her department chair told Betty that she would be teaching and planning for the 9th grade mathematics course with the department chair. “So we went into classroom to lay out the course, and the sequence of the course, and I was n— really, not needed—at all. I wasn’t consulted. I wasn't asked my opinion.” Betty pointed out that the department chair was making all the decisions for the group without listening to all the members of the team. “I really felt like walking out and just going home. I didn't see that I had any value there, nor was she really wanting my opinion—which is her right.” Betty described how another teacher, also teaching 9th grade mathematics, discussed the order of the curriculum with the department chair prior to the meeting, and that these plans were presented to the group during the meeting:

> None of the rest of us agreed with her. And you know, as usual, it was, ‘What do y’all think?’ And, I had a thought! And, she didn’t agree with me, and she tried for two days to convince that her way was right, and I didn’t agree with her... Then, we came in for preplanning, and [the head of the department] took the plan and said “this is what we’re doing.” (Interview)

Although Betty recognized her voice and used her voice to disagree with a colleague, she ultimately expressed that the department chair asserted her authority to change the teaching schedule and also to dictate the order of the curriculum. She expressed that others, some colleagues and her department chair, had more power in deciding the content and pacing of her curriculum; however, she also recognized and tried to use her voice when she disagreed with others.

Betty also demonstrated another trait of subjective knowers in that she valued "firsthand experiences as a valuable source of knowledge" (Belenky et al., 1986, p. 61). As previously discussed, Betty indicated that there were certain topics that her freshman students could not learn simply because their age limited their real-world experiences. For example, she did not believe that students understood real-world applications of driving cars or having checking accounts because they lacked the firsthand knowledge of both of these experiences. "They don't drive. They don't have checking accounts" (Interview). Therefore, Betty advocated that teachers should not teach applications of mathematics because students in the 9th grade cannot understand real-world contexts for mathematics.

In addition, she expressed that her own teaching capabilities were limited because she had not experienced teaching more difficult courses. During the interview, she indicated that her ability to learn mathematics was fixed as she was "too old" to learn more advanced mathematics. Age, a personal characteristic that is out of the control of the learner, influenced what and how much a learner could learn. Through a blog response, Betty reiterated this sentiment as she described an expert mathematics teacher. "First and foremost," mathematics teachers should be mathematics majors who are "compassionate, patient, and competent" and who explain mathematics in simpler ways for young people. She asked, "How do you teach these characteristics [to teachers]? You can't… Until you get older, you can't bring the experience to the teaching environment." During the interview, she explained that she could not teach a calculus course because she lacked the experience in practicing more difficult mathematical problems. "You get older and if you really don't practice that higher-level thinking... — it's hard." She

continued to explain that another teacher who was her age or older does teach calculus and “challenges her brain that way all the time. If I did it all the time I’d, I'd probably be able to do it.” In a sense, her younger teachers were too young to have experienced real-world examples, and therefore could not understand real-world applications of mathematics. Likewise, Betty felt her older age limited the amount of time she could dedicate to practicing more difficult mathematics, which would ultimately aid her preparation for learning how to teach calculus. When I asked her during the interview whether learning how to teach calculus was “worth her time,” she replied, “No. Not at my age.” In other words, she did not have enough time to gain the firsthand experience of cognitively challenging herself with more difficult problems that she felt was necessary for the preparation of teaching calculus. Because of this additional evidence, Betty’s dominant way of knowing was subjective knowing, and her perspective on why she learned supported a less-prominent received knowing position.

Betty’s emphasis on learning through practice and experience provided evidence that her ideological perspective of teaching and learning mostly resembled that of an industrial trainer (Ernest, 1994). The industrial trainer position includes a view of mathematics as a common set of truths and also that innate mathematical abilities are learned through effort, hard work, and practice. In the example in which she taught herself calculus in a month, she kept her promise to her professor by learning mathematics by working “every problem in the book.” With that story, she concluded that she would use similar methods to learn the content for a new course. Through these examples, Betty embodied an industrial trainer ideology of teaching mathematics (Ernest, 1994), because she believed that students learned mathematics through repetitive practice

and drills, and that her students' mathematical abilities were fixed. She discussed learning mathematics through repetition, and she valued mathematical tools, planning, and structure. She desired to learn about "Curriculum. Development tools that we need. Level of expertise that we expect the kids to do in the enriched, on level, accelerated" (Interview). Betty valued a "no frills" (Ernest, 1994) approach to teaching mathematics. For example, included among her photographs was a photograph of Betty holding up a protractor. She explained that, during the summer, she used it to make lines as she developed packet of assignments for her students. Missing from her photographs were pictures of technology, such as graphing calculators, a computer, or even a cell phone.

CHAPTER 6: MARY'S PROFESSIONAL LEARNING PROFILE

Background

At the time of the study, Mary was 39-years-old, married, and had two school-aged children. She had earned an undergraduate degree in Mathematics, a Master's degree in Mathematics Education, and an additional endorsement to teach gifted students. Having no other career before teaching, Mary had been teaching mathematics at Site 1 for 14 years. She thought about abandoning her teaching career to try something different, even though she enjoyed the flexible schedule that teaching allows. She admitted that she was frustrated with the curriculum changes in her state, and that one of the few reasons she continued to teach was because her husband was unemployed.

Photographs

Mary's photographs illustrated how she wanted to learn, why she wanted to learn, and what she wanted to learn. Specifically, she was most interested in learning about technology. She took eight photographs, six of which she ranked as her top five pictures that she wanted to discuss (she had two pictures tied for second place). Her number one self-selected photograph was of a plain, white-faced wall clock.

The second photograph that she wanted to discuss was of a round table with a glass top, surrounded by four blue vinyl chairs. She also "tied" her number two choice with a photograph of the department's floating teacher sitting at her desk, smiling. Her third photograph was a quote, posted on the wall by the main entrance of her school that read, "Success is Never Final." The quote consisted of large gold-painted letters at the top

of the wall, placed above photograph frames containing her school's crest and motto, as well as simple plaque that listed the names of the previous teachers of the year. Her fourth-ranked photograph was of her personal computer's monitor displaying a new software program for an iRespond Remote control system that was opened on it. Finally, her fifth photograph was of her LCD projector in her classroom. The last two photographs, which she merely classified as negatives of professional learning, contained photographs of her class-set of iRespond remote controls. In one photograph, a smiling student held up the remote control, and her last photograph was of the set of 30 controls tucked neatly in their carrying case. As the analysis progressed, I realized that Mary used the photographs to illustrate how she wanted to learn (through collaboration), why she wanted to learn (to adapt to contextual changes and to meet expectations), and what she wanted to learn (technology).

Perspective of Learning and Teaching Mathematics

During the interview, Mary discussed her image of an expert mathematics teacher, and whether she felt like she met her own standard. During the interview, Mary pointed out that expert mathematics teachers should be "very knowledgeable of the curriculum," and understand "how all the pieces fit together—what the big picture looks like, and why each little piece is important." Additionally, she felt that expert mathematics teachers understood how to differentiate their instruction to meet the needs of their students, and could predict how students interpreted their teaching. For Mary, all of these skills matured through a great amount of teaching experience. She observed that:

> The more you teach a subject, the better you can predict their mistakes. So, I think that a teacher who understands all that and is able to communicate that… You have to kind of find a way to engage everybody. (Interview)

Therefore, an expert mathematics teacher needs to know the entire current curriculum and the curriculum that is on the horizon to understand how all the pieces of the mathematical puzzle fit together. She suggested during the interview that expert teachers "are constantly learning and adjusting their instruction to improve it, and I think that collaboration with others takes on a large role with that." Mary also remarked that teachers needed to know more than just mathematical content knowledge to be an expert mathematics teacher.

> I think we have all encountered someone who is brilliant with math, but could never teach it. Likewise, there are those who want to teach, but do not have this MKT [Mathematical Knowledge for Teaching], and are therefore not effective in their teaching. It seems that most of our training focuses on what to teach, and even sometimes how to teach it. However, truly learning about how to teach the specific students you have, and all of the different ways they will interpret your teaching takes a lot of experience in the field. The more you teach a subject, the better you can predict their mistakes. (Blog Entry)

Mary discussed how expert teachers do not just give their students the formula or algorithm. They are able to "show them why you would choose this formula, where this formula came from, maybe they'll understand the big picture and connect that later… if they have better understanding of the way the puzzle piece fits" (Interview). Ironically, although she thinks that expert teachers should help their students make connections and understand the connections among all curricula, she did not consider herself an expert mathematics teacher by her own definition. She explained that although she is confident in teaching geometry, "I'm still learning in algebra. I haven't taught the higher levels, so I can't see where it goes 'cause a lot of times you can't see where the big puzzle is until you've taught it" (Interview).

When Mary discussed students learning mathematics, she typically described students *doing* mathematics, for instance, doing multiple choice iRespond activities or working on an abbreviated statistics task (with spinners) that she adapted from a county in-service session.

> But some of the spinner tasks and stuff like that where they had, you know, relating… What's that? Experimental verses Theoretical! Yes… I think some of those tasks kind of let them see, "Oh, look. I might get different results if I do this then actually," but what's gonna make my results come out more like their results is maybe doing it one hundred times instead of ten. (Interview)

She explained that she took an extended county task and shortened it for her students. Although she appreciated the activity's capacity to help her students learn about the differences between experimental and theoretical probability, this particular exchange illustrated that she was still gaining confidence in her statistical background. Further, as she reflected on her learning and her students' learning, she imagined completing the task from the student perspective. However, she did not describe assessing the activity based on evidence of student achievement.

Professional Goals

Mary did not have any intention of retiring in the near future. In a follow-up email with Mary, she mentioned that she wanted to teach more geometry classes because she is "more confident in geometry," and that she wanted to stick around and help build a foundation for the new 9^{th} and 10^{th} grade courses over the next couple years. She felt invested in the curriculum because she had been teaching it for so long. In a letter she wrote to her department chair, which she shared with me, she stated that although she wanted to teach more advanced classes 10 years down the road, she wanted to spend the

next five years preparing a strong foundation for the new 9th and 10th grade mathematics classes.

> Typically, the ninth and tenth grade classes go to younger, inexperienced teachers who have no other background than to follow the state guidelines presented to them. I feel we owe [our students] more—to be sure that they are given what they need to succeed not only on the state [tests], but on the SAT, upper math classes, and in life in general. I just don't feel comfortable moving on and leaving the planning to younger teachers with less experience, who may happen to be fantastic teachers in the classroom, but when it comes to providing guidelines and materials without textbooks or structure from the state curriculum, I would just rather feel like I could play a better part in making the foundation more solid.

Mary felt confident in her curriculum knowledge of algebra and geometry, and therefore viewed herself as better equipped to build a strong curriculum foundation than the newer, less experienced teachers in her department. She defined her comfort zone around both her content knowledge and the level of her students. Once she felt satisfied with her contributions to her team and her students, she would then feel ready to step outside of her comfort zone to teach different or more advanced subjects. She thought younger, less experienced teachers are not as capable at planning a new curriculum. These goals revolved around her confidence in her experience and content knowledge, while illuminating her insecurities about stepping outside of her comfort zone to teach something new.

During the interview, Mary talked at great length about wanting to learn about technology and her frustration with not having the corresponding support from her school district for learning how to use technology. For example, several of her photographs focused on her iRespond system. The iRespond remote system allowed teachers to give closed-ended questions to students through a PowerPoint format or through a written assessment for which students selected an answer. Students then used the remote control

to lock in their choice, and in turn, the remote wirelessly sends the choice to the teacher's computer. The teacher can monitor the class's overall scores and individual student answers. Mary believed the county spent around $1,000 per iRespond system per teacher, and that her school district invested in the iRespond system to monitor teachers, rather than student learning. To Mary, the photographs of the iRespond system were a negative aspect of professional learning. She explained:

> These kind of all tie into my negative. This is my iRespond being used [Mary gestures to photograph of the student holding the remote control]. This is my iRespond *not* being used. Everything is in the box. (Mary smiles.) So, they have spent so much money and so much time getting us to learn this, right? And this is where mine sits most of the time—in the box. I don't, I don't get to use it, and when I *do* get to use it, does it really make my classroom that much better? No. I feel like that the only reason why they spent *all* this money on *all* this technology and *all* these trainings was so the 'Big Brother' could look over our shoulder and that the county people can say "Huh. Let's see how they did on their first test." Well, if you wanna know, then just ask me. (Interview)

Figure 8. Mary's Photograph of Her iRespond Class Set of Remote Controls

However, Mary also discussed how she had used the system to monitor her students as well. She pointed out that her students were more likely to complete the

assignment because they knew that she could see their choices on her monitor. She elaborated:

> And [the students] can talk and chat and do it or not do it, but if they know they have to do it in there [motioning to the remote control] they're like "Well, you know, I actually have to do this, because she wants me to put it in and she's looking in the computer and she knows which ones I have and haven't done." (Interview)

Mary believed that the iRespond system exemplifies how her school district pursued expensive initiatives to promote the use of standardized assessments while inadvertently monitoring students' progress and by-passing the role of the educator. Mary resented having to attend mandatory training sessions to learn how to use iRespond remote controls, particularly because she was more interested in learning different types of technology. However, she was not offered support for the tools that she was most interested in learning. For example, Mary took a photograph of the LCD projector in her classroom. During the interview, she pointed to the photograph of the projector said:

> This is a positive technology use, except nobody ever trained me on it. So I had all this training on all this [pointing to the photograph of the iRespond system], right. But, I never had training on this [pointing to the photograph of the LCD projector]. I just, I got an e-mail. It had "this button does this and this button does that," but I never got training on it. (Interview)

Although Mary believed the LCD projector improved her instructional practices, she received little training or support when she learned how to use it. Conversely, she received a great deal of training for the iRespond system, yet she rarely used it because it did not support her method of teaching. This juxtaposition of access to desired technology without support verses undesired technology with mandated support demonstrates Mary's frustration with and mistrust of her school district—a district which she felt did not support or understand her learning goals. When Mary was not provided

support for technology, she often sought out a peer to help her learn to set it up or integrate it into her instructional practices.

Figure 9. Mary's Photograph of Her LCD Projector

During the interview, Mary stated that when she first checked out her document camera, she did not know how to connect a document reader to her computer. When she realized she needed help, she sought out a colleague who had had experience using the tool. She reflected that the document camera has changed her instructional practices.

> They installed it for me. Showed me how to focus it. Showed me what I could use it for, like how the software would work if I actually could take pictures and save that… That's a thing that's the center of my instruction now, but I had no training on it. I had to do my own training or find people to train me.

She did not have a SmartBoard, and yet she recognized that she would need to learn how to use a SmartBoard if she ever received one. "I need to know how it works. I need to know what's useful… how to download something to a blog" (Interview). Mary spoke about various types of technology, such as the iRespond System, document cameras, her LCD projector in her classroom, and SmartBoards, and pointed out that she needed to have time with the tool in order to learn it.

> You just have to spend time with it. And I just don't have the time to spend with it. So I just pick one thing at a time that I can focus on, like I got my document camera and spent time with it. Love it. So I just totally rely on that… but the thing is, you have to make yourself do it. So, unless

> you are really in a situation where you can, not necessarily even be trained, but have someone there that knows how to do it, and have you work where when you come up with questions they can tell you the answers to them. And we just don't have the time to do that. (Interview)

Mary valued accessibility to and support for technological tools, and she felt that she needed to be able to spend time with a tool in order to learn it. Although Mary was interested in learning how to use technology, she did not actively seek out these tools for herself. Oftentimes, they were introduced by an outside source, such as her school district. Although she took several photographs of technology (including the LCD projector, a computer, and an iRespond remote control unit), she spoke of the importance of the photographs in terms of how much support she was given once the pieces of technology were in her classroom. Only then did she have an immediate need to learn how to use it; during these times, she was either provided the support or was forced to figure it out for herself. During the interview, she did not speak of independently figuring out how to use these tools. Instead, Mary discussed these tools within the context of being supported by other people, either her peers or through training sessions. Therefore, her goals of learning technology became immediate when an outside source provided tools, prompting Mary to desire the support to use them. In all of Mary's discussion about technology, she did not discuss using technology as an investigative tool for learning mathematics. Instead, Mary discussed how these tools enhanced her instructional practices by helping her to present mathematics to her students, rather than allowing students to discover mathematics for themselves.

When Mary spoke about learning, either students' learning or her own, she emphasized that a great deal of time and practice was needed in order to build knowledge. For teachers, Mary felt that she was more qualified than less-experienced

teachers to build a solid foundation for the freshman and sophomore mathematics classes. Likewise, the only examples of student engagement mentioned during her interview included activities in which students completed multiple choice problems (which she rejected as effective for helping students learn mathematics) and a spinner activity (which she liked because she felt students made connections between theoretical and experimental probability). In addition, when she spoke about learning technology, Mary explained, “I feel like the only way to get good at that is to actually use it. And I would be using it over and over and over again” (Interview). Therefore, even in her own learning, Mary emphasized the importance of repetitive practice in order to learn a skill or gain knowledge.

Overall, Mary’s goals revealed that she wanted to stay in her comfort zone of teaching freshman and sophomore mathematics classes. Although she was willing to learn technology, she did not actively seek out these opportunities for herself because there “just is no time to do so” (Interview).

Motivation to Learn

Prior to the interview, I reviewed Mary’s photographs and reflected on each photograph’s association to professional learning. At first glance, I thought Mary’s photograph of a clock indicated the opinion that professional learning was a waste of time. This would have paralleled one of her survey free-response answers when asked to describe professional learning in three words. However, during the interview, Mary’s explanation of the photograph was more meaningful and symbolic, revealing her motivation to learn.

Figure 10. Mary's Photograph of a Clock

She ranked this photograph as the number one photo that she wanted to discuss during her interview. During the interview, she explained that time and changing contexts should actually motivate educators to learn. Therefore, Mary rationalized the necessity for professional learning because she wanted to adapt to an ever-changing classroom context. During the interview, she used the story of Rip Van Winkle to illustrate the fact that educational contexts did not change for many years; yet the introduction of new, innovative types of technology has changed educational contexts as well as also promoting the need for teachers to foster collaborative activities.

> That's the reason we have to have professional [learning] because time constantly changes things. We're constantly having new software, new textbooks, new problems in the world, so that's the reason we have to have professional [learning]… You know that story about Rip Van Winkle who fell asleep for one hundred years and he woke up and he couldn't recognize anything and then he walked into a school and he goes, "OH! I remember this!" because everything was just the same, right? … I think they are starting to realize out in the real world that, um, the old way of doing things doesn't really prepare you for today's world. Today's world is full of technology. Today's world is full of collaboration, you know… It's just not the same world where it used to be. You know? So, I think that technology does make life better. (Interview)

When it came to enhancing her instructional practices, Mary adapted to her changing educational contexts by learning to use various types of technology. She became frustrated by the incongruence between accessibility of technology and the accessibility of support for the technology. So, one reason why she sought out professional learning was to get technological support for the new instructional tools that helped her adapt to changing educational contexts.

Methods of Learning

Mary's other photographs emphasized her desire to learn through collaboration. She explained that she took the photograph of the roundtable because "I think that the best way to have professional development is roundtable style where everyone has, um, input… I think that you could learn something from everyone" (Interview).

Figure 11. Mary's Photograph of a Round Table

This photograph captured Mary's philosophy of how professional learning should take place. Specifically, she wanted to work with teachers at her school who understood the needs of their students and the expectations of their educational community. Mary's photograph of the quote, "Success is Never Final," also captures her expectation of contextual professional learning. She commented that she believed professional learning

conducted at other sites, such as at a different school during in-service days or at a local university, was not as helpful as professional learning sessions done at Site 1. She explained:

> It's like, so many of the big group of people out there are trying to get where we *are* and we're trying to get *farther*. And we're saying, "How can we take what you're saying here and make it better?"… I feel like we get more out of collaborating with us than with collaborating with others… I think that site-based [professional learning] is much better. (Interview)

With this quote, Mary demonstrated that she desired to work with her colleagues at her own school, not merely out of convenience, but because she believed that her colleagues understood her learning needs, coped with the same challenges, and shared similar educational expectations for their students. She perceived her school's scheduling, access to technology, and high expectations as shaping her learning needs and the learning needs of her peers. Additionally, the department's expectation that each subject area prepare common assessments and follow the same pacing perpetuated a need for all the teachers to be consistent in their practice. Because a common planning period was not provided by the administration, Mary explained on the Professional Learning Discussion Board why the somewhat mandatory common planning time after school was intentional, useful, and necessary, especially as the group adapted to the state's new curriculum. The changing curriculum also perpetuated Mary's need to collaborate because she wanted to create materials, assessments, and finalize the pacing of the course.

> With all the new curriculum & technology changes, there is a great need for trainings but no money. As a result, teachers don't want to give up their time for free. (Professional Learning Journal Entry)

> At my school, we are required to give the same assessments on the same day. This promotes collaboration in that we all have to agree on what is taught and how to test it. However, we do not have time for common

> planning, which makes it difficult for everyone to find time to meet and discuss. (Blog Entry)

In another blog entry, Mary explained that she valued collaborating with her peers for multiple reasons, even when her peers resisted the process. In fact, she preferred that common planning be mandated because "it always seems the more we make the time to work together, the better the results… It would be great to have common planning with mandated attendance at least once or twice per week." In a separate post on the Professional Learning Discussion Board, she reiterated these sentiments and elaborated on how her teaching team scheduled time after school for common planning. The group formed out of the necessity to provide support especially as they adapted to a changing state curriculum.

> I am a big supporter of "common planning" time. And I really believe that the common planning should be with people who teach the same subject, and even level student, that you do. With the initial change in curriculum to integrated math a few years ago, we decided as a team to have required meetings once per week—this was great! Sure, some people didn't want to be there and complained, but ultimately, we got a lot done. We had time to agree on how to teach the new content, how we would assess the new material, what our pacing would be, what was the best way to teach it. (Blog Entry)

Mary found this time "comforting" because the group was able to bounce ideas off one another. Mary prioritized common planning to such a degree that even when it was not provided to her, she and her collaborative team worked together to carve out this time to work together after school. She overlooked her peers' complaints because she felt everyone benefited from having the time to agree on how to teach, what to teach, when to teach, and how to assess the students. Mary specified that this collaborative time should be mandated, but it is unclear exactly who should mandate it. Additionally, why her peers resisted the process or what her peers found actually meaningful about the experience

was also nebulous. Although this collaborative time exemplified Mary's roundtable photograph, it was unclear as to whether each member of the team ultimately had equal input in the curriculum planning. As I read Mary's blog entries, I could not help but wonder what exactly Mary was learning as she collaborated. Was she planning curriculum or professionally growing?

Clearly, she identified that one avenue for growth was learning how to use technology. As previously described, she learned how to use the iRespond System, a new LCD projector, and a document camera. However, how did Mary learn to teach new content? During the interview, I asked Mary how she would approach teaching a new course for the first time. She described this process as follows:

> I would try to go on YouTube or just on the Internet and see people actually teaching it. You know, like look at their lessons and be a student in their class, you know. And, um, maybe if there's a particular topic that I don't feel comfortable with, look at several people's presentations, you know? Because I feel like, if you don't quite get it then [the students are] gonna pick up on that. They're gonna be like, "Oh. She doesn't even know what she's talking about," you know... Just be a student in his class and see what the kids ask him… How did he connect things? … And then I go to somebody who teaches it all the time so that they, so I can see how they connect it… They have some insights to tell you that you're not completely ignorant to where you're wasting their time saying so what are the steps, you know? So, that's what I usually do… I learned the topic first, and then I asked them how they, how do they kind of make it connect.

Of course, Mary hoped that she could utilize common planning. "People who say they have common planning, I am so highly jealous because they have professional development every day!" (Interview). She indicated that she would like to have the same lunch period as a colleague who is currently teaching the new course because "you are going to have questions every single day." However, she also pointed out during the

interview that it would also be “ideal” to have her lunch period while her peer was teaching the new course so that she could observe him/her.

Positive and Negative Learning Experiences

Mary embraced peer observations as the preferred manner of professional learning. In one blog post, Mary noted that she found informal observations more beneficial than the peer coaching process because her peer’s feedback did not have to focus on just one learning goal. She valued collaborating with her peers through both classroom observations and collaborative discussions.

> I think that my best learning experiences have been through observing other teachers in their classrooms… I think that the most benefit has come through simply opening up our classrooms to one another informally. When I get to watch a fellow colleague in the classroom, I get so much out of the observation—more than you can define with just one goal. And I like to hear other teachers’ comments about my classroom without having to focus in one area—just hear what comes to their mind after the observation. I think that the second best opportunity to learn is through informal discussions with my colleagues before or after school. It would be great to have a common planning time, so that we could do more of this. As far as what I’ve learned through my experiences, I do believe it has benefited and continues to benefit my students as I learn new ways to present material, manage my classroom, arrange the curriculum, etc. Ultimately, increasing student learning is the goal. (Blog Entry)

Mary pointed out that improving student achievement motivated her to improve her instructional practices and content knowledge; however, she did not discuss how she assessed her professional learning experiences through her students’ learning. Mary mostly valued human resources throughout the learning process. When Mary learned new content or new technology, she sought out peers to show her how to use the tool or share insightful connections to curricular standards. She observed them, collaborated with them, sought their guidance, or developed curricular materials with them. She selectively chose her collaborators, as she most closely relates to those who understand or share her

learning goals. Why is collaboration so important to her? Does she think teachers could learn independently?

> Most of what we gain is coming from other people giving a different perspective… Just the other people around you giving their perspective in… the roundtable is really where you grow. You can only go so far within yourself. (Interview)

For Mary, independent learning comes naturally, yet she believes that people are ultimately limited in how much they can grow. She posited that collaboration opens up doors to different perspectives and different types of expertise, which helped her ultimately adapt to new contextual classroom changes that occur through technology or curriculum changes imposed upon her through state mandates. Under such conditions, she consistently turned to her peers within her department, not administrators or mathematics teachers at other sites, to help her prepare, plan, and learn. She even advocated that common planning be mandated. Ironically, her least favorite and most undesirable types of professional learning were typically associated with sessions that were imposed upon her by her school district. In one blog post, she mentioned that she would rather be planning than have to listen to some "motivational speaker."

> My worst learning experiences have been formal large group settings where everyone in the whole school attends during preplanning. At times, this has been a motivational speaker to start off the year. We're motivated, we've had the summer off, and we'd rather have the time in our rooms to get ready. There was also that one time we had to all learn how to grade the writing portion of the SAT. Pretty useless to me as a math teacher. I think that these experiences actually probably hindered the learning of mathematics for my students, because I could have better spent the time preparing for the first week of school.

During the interview, she explained that sometimes the most irrelevant professional learning sessions were provided by her school district to help her learn how

to use technology that she cannot access or promote instructional strategies the she would not embrace.

> They are going to pick technology I don't use or don't have. They're going to pick content that I, you know, am not going to do the same way they do. They're gonna pick strategies that may not work for my environment. (Interview)

Mary pointed out that professional learning should be relevant to her educational contexts and content she taught. Why?

> Because the time, the clock, it's always changing, but I don't think that how it's presented should be required. I don't think we should all have to go to the speaker once a year on, you know. I think it should be more local and more collaborative rather than somebody standing up there and lecturing. (Interview)

Therefore, although Mary valued collaboration, she only wanted to collaborate with her peers at her school. Although she would prefer that common planning be mandated, she does not want to be forced to go to professional learning sessions provided by her school district when they do not relate to her learning goals, which revolve around adapting to an ever-changing educational context.

Belief Systems

Much like Betty, Mary valued the openness of her peers during the learning process. She preferred to collaborate with her peers at her school. Mary recorded in her Professional Learning Journal that she believed that she benefited from working with teachers who teach "the same thing to the same type of students… I just can't seem to learn as much from people outside my department or even people inside my department that don't teach the same level of student." Mary hoped to collaborate with teachers who matched her context, content and student. During the interview, she pointed out a

photograph that she took of a sign on the school's wall that read, "Success is Never Final."

Figure 12. Mary's Photograph of "Success Is Never Final…" Quote

She explained that teachers at other schools "are trying to get where we are and we're trying to get farther… I feel like we get more out of collaborating with us than with collaborating with others." Mary primarily used external human resources, such as her colleagues or professional learning sessions, to learn how to use technology. As she described in the interview, when she needed to learn how to use and set up her document camera, she sought out a peer to help her get started. However, when the district provided her an iRespond remote control system, she did not use it because she did not feel like she had enough technology support from her school district to learn how to use it.

When learning how to teach mathematics, she pointed out in a blog response that she enjoyed peer coaching because she liked to "hear other teachers' comments about my classroom without having to focus in one area—just hear what comes to their mind after the observation." This type of feedback allows others to provide constructive criticism without necessarily learning from her. Mary sought to learn from their feedback. She indicated that she learned by observing others. For example, during the interview Mary

described learning how to teach a new course by first going online to "see people actually teaching it. You know, like look at their lessons, and be a student in their class." Moreover, she sought to learn from teachers who taught within similar contexts or taught the same content matter. Although she claimed to learn by connecting with others, Mary did not mention learning *with* her peers. Her specific examples of observing others through peer coaching, Internet videos, or assistance with technology illustrate what she learned *from* her peers. She viewed other people as the primary source for knowledge, and therefore, her way of learning most resembles received knowing. As a received knower, Mary relied heavily on observations of others and spoke of authority figures outside of herself.

She viewed the role of her administrators as those who had a great deal of power with scheduling, mandating attendance at professional learning sessions, and holding employees accountable for their actions. During the interview, Mary noted that her administration looked for "red flags" in the form of teachers who had too many failing students in their class. She explained, "I don't blame them, for you know, checking stuff," such as teachers who had a disproportionate amount of failing grades. Additionally, Mary also noted in her Professional Learning Journal that administrators hold teachers accountable for professional learning. "I feel that anytime the [administration] mandates that we participate [in professional learning], they have their own way of checking (paperwork) what was accomplished." Inevitably, she also wrote within the margins of one article that teachers will not attend professional learning sessions "if it's not required." She trusted authority figures, such as administrators or district personnel, to monitor teachers' professional practices and hold them accountable

when they were not fulfilling their professional obligations of collaborating or effectively teaching their students. She did not doubt this authority, and she believed that her colleagues benefit from mandatory professional learning sessions.

In terms of her stance towards teaching and learning mathematics, Mary's ideological perspective of mathematics education most resembles the technological pragmatist (Ernest, 1994). Mary believed that expert teachers would be engaging and knowledgeable about the mathematics curriculum, and she did not think that she was an expert mathematics teacher because she had knowledge gaps related to higher-level mathematical classes. Mary valued knowing the full depth and breadth of mathematics. She also believed that the more teachers taught a subject, the better equipped they became in learning how to interpret the student questions. Ernest (1994) posited that technological pragmatists viewed mathematics as an "unquestioned body of useful knowledge" (p. 138), and that they believed that learning took place by acquiring skills through practical experience. As Mary discussed about learning how to teach mathematics, she emphasized that gaining experience in the field helped her to broaden and deepen her knowledge of her students and her instructional practices.

> Truly learning about how to teach the specific students you have, and all of the different ways they will interpret your teaching, takes a lot of experience in the field. The more you teach a subject, the better you can predict their mistakes. You can change your teaching to emphasize what is important and catch mistakes before they happen. Through these experiences with students, you can learn what different ways of presenting the material will resonate with which type of student. (Interview)

Here we can see that Mary was concerned, not only with guiding the students to the right answer, but also with anticipating her students' mistakes as they learn new material. Mary also felt obligated to help her students prepare for their changing contexts

by preparing them to collaborate and use technology. “They’re gonna be in the real world” (Interview). Mary was motivated to learn because the clock, which she described as “always ticking,” ultimately changed the contexts for teaching and learning. She wanted her education to prepare her for future contexts, and she valued hands-on technological tools. Many of her photographs included technology, such as an overhead projector, her iRespond remote controls, and her laptop computer, because she ultimately wanted access to and support for technology. Mary was motivated to learn about technology and curriculum when it related specifically to her workplace. “We’re constantly having new software, new textbooks, new problems in the world, so that’s the reason we have to have professional [learning]” (Interview). This perspective also echoed that of a technological pragmatist (Ernest, 1994) in that she was motivated to learn work-related or relevant skills. During the interview, she pointed out that she needed to learn how to use a SmartBoard because “eventually I’ll have one of those (pointing to a SmartBoard). I need to know how it works. I need to know what’s useful… [like] how to download something to a blog.” For her, the necessity for professional learning increased as she could directly relate the professional learning content to her exact current teaching contexts or her possible future contexts.

CHAPTER 7: LUCY'S PROFESSIONAL LEARNING PROFILE

Background

Lucy is Caucasian and 25 years old and had been teaching mathematics for four years at Site 1 during the time of the study. Lucy had been married for approximately two years and did not have any children. She hoped to start a family, and mentioned that when she did have children, she wanted to take some time off from teaching to focus on raising a family.

She taught 9th grade algebra and a 12th grade mathematics class in which students applied various topics of Algebra 1, Statistics, and Advanced Algebra topics to real-world applications. Both of these classes were comprised of students who either did not meet grade requirements to be in a more advanced version of the course or who chose to take the class. Educationally, Lucy had earned both undergraduate and Masters of Education degrees in Mathematics Education, and she did not have any additional teaching endorsements. In addition to her teaching responsibilities, Lucy also volunteered as an assistant coach for spring sports and sponsored more than one club at her school.

Photographs

Using the provided disposable camera, Lucy only took five photographs. Therefore, prior to the interview, I asked her to rank photographs from first to fifth in the order in which she would like to discuss them during the interview. Her top three photographs included some type of technology, and her fourth-ranked and fifth-ranked photographs related to content and classroom management, respectively. Although Lucy

did not take as many photographs as some of the other participants, I did notice that all of her photographs captured her learning goals.

Her first-ranked picture was of her tablet. It was in a black case, turned off, and positioned on top of her desk surrounded by various office supplies, such as Post-Its, pens, and a graphing calculator. Her second-ranked picture was of a ClassPad. This tool was about the size of an tablet, with a stylus attached by a piece of string. The device wirelessly communicates with a base that is hooked up to a teacher's personal computer. As the teacher writes on the ClassPad with the stylus, the teacher's notes are recorded wirelessly to the program opened on the computer, which is projected to the class, allowing the teacher to move freely about the classroom. Students can also use the device at their desk to work out problems as their work is projected on the board. Lucy's third photograph featured her phone, lying on top of a notebook pad. Her other two photographs showcased that she was interested in learning about mathematical content and classroom management. Her fourth picture included a bookcase shelf lined with seven three-ring binders. Each binder contained a different unit for the senior mathematics class she taught. Lucy's final photograph included three unit calendars taped to her classroom wall. Each calendar represented a different subject she taught. At the beginning of the unit, Lucy distributed the calendars to her students so they would know the pacing for the unit, their homework assignments for each day, and dates for their assessments. Below the calendars was a small table on which there were three wire baskets used to gather extra copies of worksheets for each corresponding course.

Perspective of Learning and Teaching Mathematics

As both the youngest and least experienced teacher involved in this study, Lucy's perspective of teachers learning to teach mathematics focused on her experiences as she became acclimated to teaching (through floating) or through her experiences of formal professional learning sessions provided by her school district or her state. She was eager and receptive to learn from other people, notably asserting during the interview that she valued human resources and sought out her peers in the hopes that they would answer her questions. "I think that most learning occurs informally when you want to figure something out. You ask the appropriate questions and persons necessary to come to the correct conclusion."

Lucy was open to new ideas. When initially exposed to a new idea, she evaluated the strategy to assess whether she could actually implement it. Then, she just shrugged and stated, "I mean, if I've never done it before, I'll probably just try it" (Interview). She was also willing to work collaboratively with and observe her peers. For example, even though she had not been trained in peer coaching, she noted that she thought that it was a great idea.

> I think it would be more helpful for me to watch another teacher teach and then have them watch me teach, than for an administrator to come and watch me teach and offer suggestions—especially if the administrator is not knowledgeable of the content. (Interview)

Because she valued observing others, she discussed how floating during her first two years of teaching at Site 1 helped her to grow professionally. During the interview, she was reluctant to admit that she enjoyed floating, yet she pointed out that the process helped her stay organized and exposed her to new ideas through observing other people in the department.

> I just saw everyone's little ways of doing things and picked my favorite. (Laughs.) It was good, actually. It helped me keep organized… If you are in a different class every period, you need to have everything exactly where it needs to be, and you have no time to put it anywhere else. (Interview)

> I saw other teachers [*sic*] styles of setup, how they ran things, and I could ask them for suggestions since I had another experienced teacher in the room with me. From this I learned different management styles and ways to collect homework, tardies, etc. I totally stole ideas I liked from certain teachers to incorporate in my classroom now. (Blog Entry)

It is through this open-minded perspective of learning that Lucy described how she felt about herself as a learner. During her interview, she asserted, "I would definitely want to learn. I would want to know how it's used and why it's more effective than what I'm doing now, I guess... So, I'll listen to anything!" Additionally, on the blog, she talked about her perspective of her learning process with respect to her students. "I have never compared myself as a learner to my students as learners. I have always taken the attitude that I will always learn, which I guess in return hopefully this is reflected to my students." Therefore, ultimately she wants her students to see her modeling a love of learning.

Ironically, most of her blog posts and interview transcripts omit the discussion of students' learning of mathematics. However, she did state that she sympathized with her students as they are hurled into adjusting to a new curriculum with their teachers. Specifically, she recalled during the interview how she attended a state-provided training session on teaching a brand new course for struggling seniors. After taking primarily traditional courses in Algebra 1, Geometry, and Advanced Algebra topics, these seniors took an alternative course to precalculus. The alternative course was primarily project-based and filled with real-world application of mathematics. She brought back and tried

to implement many of the session facilitators' suggested strategies; after the school year was over, however, she was left feeling frustrated.

> *Lucy:* These kids have never experienced anything like that and they are just thrown into this their last year of high school and they're, they're just (pauses)… I think parts of it were good ideas. (Pause) Some of them were hard to implement and some of them might have actually been good.
> *Rebecca:* The ones that were hard to implement, why were they hard to implement?
> *Lucy*: Because, I mean, it's not utopia (laughs) in the classroom. We have kids that miss all the time... I don't know if it was created for the kids we have in there. (Interview)

Therefore, she still maintained an optimistic spirit about trying new ideas, but her experiences in the classroom had begun to shape her discernment regarding types of ineffective professional learning. Because she was a new teacher, Lucy had not taught mathematics prior to the curriculum reforms. Further, she had only taught 9th grade mathematics and 12th grade mathematics during her four years of teaching. Therefore, although her content area knowledge stayed homogeneous over the past four years, Lucy's experiences of observing different teachers provided her greatest opportunities for professional growth.

Who does Lucy look up to? How does she define an expert teacher? On the blog, Lucy discussed expert teachers' interactions with others. "I also think an exceptional math teacher is collaborative in a professional, meaningful, and constructive way." But what does it take to be an expert mathematics teacher? During the interview, Lucy articulated her image of an expert mathematics teacher.

> *Lucy*: When I think of good math teachers, I think, "Well, she is good because she does things like *this*." And I like that part of it. But, she's good because she does, th— you know what I mean.
> *Rebecca:* So, what was the first this? She's good because she does—?

> *Lucy*: I guess, like a lot of people, what I think of as good math teachers [is that they] know the content well, or they choose higher-level classes. I don't know.

Combining these two thoughts, Lucy believed that expert mathematics teachers are collaborative, knowledgeable of the content, and teach upper-level mathematics courses. During the interview, when I further probed as to whether she perceived herself as an expert mathematics teacher, not only did she say, "No," but she further provided additional details about expert teachers' characteristics.

> It makes me feel like I have to *know* everything. I can't say I'm an expert teacher, that I like, I don't make mistakes ever… I think you need to constantly, to a, like—*share*. What is the word? Like smooth edges. I guess. Like this didn't work this way, so next time we're going to change it. You know. I guess just reflect on the fact of what worked and what didn't and keep going from there. This is hard. I mean, an expert math teacher, you need to know the content. You need to know, like, not just know the content, but where you're going with it and where you've came [*sic*]—you know… (Pause.) The hard part. (Laughs and pauses.) Like effectively communicate (pauses)… the content that they need to know, I guess. But, that is like a whole area of the effective part! (Interview)

Initially, the concept of being an expert mathematics teacher overwhelmed Lucy because of the assumption that expert mathematics teachers "know everything." However, she pointed out that this was not what she truly thought of as expert mathematics teachers. They should know mathematical content, but they should also be willing and able to evolve in the classroom. Additionally, they must be able to effectively communicate what they know. Lucy later clarified in a follow-up interview that "smooth edges" equated to evolving professionally in the classroom. Her description illustrated that she believes that adaptation is an integral part of being an expert mathematics teacher.

Although Lucy did not see herself as an expert teacher, she did see herself as a "forever learner." In a follow-up interview, Lucy revealed that she wanted to be a forever learner, and thought that she was sometimes. "I think I go through phases. Teachers *should* be forever learners because they ought to try to evolve." Although teachers should be forever learners, she candidly admitted that she was not there yet. However, Lucy conceded that her follow-through on learning could be inconsistent. She noted during that interview that some days, she felt that she should "work better on this. Then, other days, I'm like 'Ugh. It's good enough as it is.'" Although she realized her motivation to professionally evolve fluctuated, she thought that being a "forever learner" was a vital aspect of the change process because "you should always try to evolve or change."

Professional Goals

Lucy's long-term goals changed throughout the course of the study. Lucy explained that at the end of the semester, her department chair requested that each of mathematics teachers in her department email their five-year career goals to her. The department chair indicated that she was going to take the mathematics teachers' five-year plans into account when developing the teaching schedules for the following school year. Lucy emailed her five year plan to me after the interview. Within this email, she detailed how she enjoyed teaching lower-level students, but she could not physically teach lower-level students all day long. "They drain me." Although she intended on teaching at Site 1 over the next five years, she wanted to teach a mix of low-level students and on-level students. Eventually, she wanted to teach more advanced curricula beyond the content of 9^{th} grade mathematics, such as Advanced Algebra or Trigonometry. However, when the next school year began, Lucy's teaching schedule included mostly low-level courses. In

an email follow-up, I asked Lucy how she felt about her teaching schedule. She then reflected about the aspects of her five-year plan that her department chair could have considered.

> I don't know if [the department chair] took my plan to heart or not. She definitely understood I have the patience to deal with lower-level kids but did not understand the part about it not being right to have all lower-level or all upper-level kids. I like the mix. I was originally semi-pissed about the schedule... Then I kind of saw the parts [the head of the department] took from my five-year plan to make it and accepted it and have kind of changed my goals around for next year. (Follow-Up Email)

I was surprised that she pointed out that her goals were changing due to this teaching schedule. By keeping in touch with Lucy throughout the semester, I discovered that she became increasingly dissatisfied with her job. She was made subject area lead for the 9th grade mathematics course and was working with both Betty and Mary at the time. Not only was she overwhelmed by the process of having to create new materials for the course, but she felt that she had to appease everyone within the teaching group in the process. As tensions built, Lucy broke down and told her department chair she did not want to come to work the next day. According to Lucy, the department chair listened to her concerns and assured her that she would not have to work with the same team-members the following semester. Lucy felt valued when her department chair demonstrated that she would go to great lengths to keep her in the department. Unbeknownst to the department chair, Lucy had already been looking for teaching jobs at local private schools. During our follow-up meeting, Lucy explained that her plans had changed drastically since the beginning of the study. She now wanted to continue to teach until she had children. Then, when they started school, she would consider returning to the profession; unlike her perspective at the beginning of the study, she now considered

teaching at other schools. She pointed out that because her conversation with her department chair, she had gained confidence to talk with the department chair about issues that were bothering her.

In terms of professional short-term goals, Lucy claimed on the blog that she set her own goals. “I, ME ME ME, set the goals for professional learning. It’s scary that some teachers may never do that.” Although she did not want to be to pigeon-holed into teaching the same types of classes all day long, she asserted that floating met many of her professional learning needs. “I always want to learn about ways to be able to run things more smoothly… I’m gonna have to keep up with the curriculum too!” During the interview, Lucy explained that she looked to her peers and technology for class management strategies and tools that she could use in her classroom every day. She invested her own money in these tools, and she sought out colleagues to help her learn how to use them. Although she noted that she wants to learn content, during the interview she recalled participating in professional learning courses centered on instructional practices. This learning goal was supported in her photographs of technology, classroom binders, and subject pace guides, which underscored her primary learning goal—classroom management.

Instead of photographing how she wanted to learn (like Betty and Mary), Lucy took concrete, not symbolic, photographs of exactly what she wanted to learn: technology, content, and organization. At this point in the study, she focused on short-term goals in the classroom. However, her long-term goals have not yet materialized. She focused on developing who she is “now” as a teacher and wanted to learn coping skills for management in the classroom.

> Well, I ranked technology first because if we're talking about professional [learning], that's what I would want to pursue with professional [learning]. [Lucy pointed at the picture of the three-ring binders.] This was for content. 'Cause obviously I want to go for content at, you know, to just keep studying to make sure I know what—And then, this was for like, um, the calendars… like how to run your classroom effectively to make sure that you are meeting all the needs. (Interview)

When I asked Lucy why she ranked the tablet as her top ranking photo, she explained that it was an extremely powerful tool that she bought for herself. She wanted to learn more about how she could use both the tablet and the ClassPad every day. Additionally, she wanted to also use her cell phone as a classroom management tool. "Cause I use my cell phone every day in the classroom… I'll take pictures of the homework or even for the app [cell phone application] where you can mark them tardy." She liked the fact that these forms of technology eliminate the need for paper and allow her to "keep track of a lot more things" (Interview).

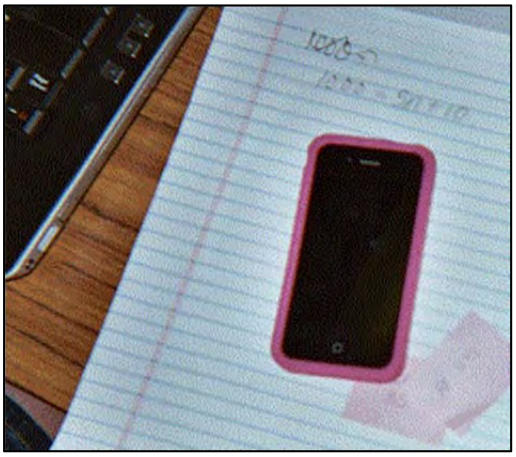

Figure 13. Lucy's Photograph of Her Cell Phone

Lucy suggested that she is better equipped to set her own learning goals because "they're higher than what others set." She went on to elaborate:

> I don't know that they set them, I just think that… my standards are a little higher. I just don't want to be average… [W]hoever sets my goals, I mean, they don't really know me at all. (Laughs.)... I see why they set these

> requirements just because some teachers need it, but I don't think someone setting my goals really makes sense at all. (Interview)

Lucy also aimed her sharpest criticisms toward her school district's provided in-services.

> [T]he worst learning experiences are in the meetings that all teachers attend. I guess the county organizes those, I'm not sure. Usually I feel like they are trying to reach the "lowest common denominator" in the group, and I understand it so easily that it just scares me that there are people out there that really might not be able to figure Outlook out on their own. (Blog Entry)

Lucy had set the professional goal of earning a graduate degree. During the study, Lucy was pursuing a Specialist degree in Instructional Technology. She explained that she wanted to maintain an optimistic mindset for continued education, even when she is no longer in graduate school.

> I just want to keep the same mindset going forward so that it's not that I'm in grad school, but I'm still kind of exploring new—… cause, I mean, in grad school you're forced learn about these different methods and new ways of teaching or whatever it is. So, I kinda wanna just continue that just without the grade, I guess. But it's gonna be hard. (Interview)

During the interview, Lucy demonstrated that her motivation to learn wavered when given the option to learn. For example, after Lucy elaborated on her experiences at a state-mandated professional learning session, I asked her if she thought she would have gone to the session even if it were not required. She responded, "Ahh. I would hope I would, but I don't know if I would. Just because that's, you know, another week of summer." She had the desire to be a motivated teacher, but she realistically evaluated her intentions and stated that she did not know whether she could live up to her own expectations.

As Lucy discussed her strengths and her learning interests during the interview, she was less transparent about the areas of insecurity or weakness other than motivation. Even still, although she desired to learn about classroom management and content, she placed a great deal of emphasis on becoming a learner. Although she insisted that she had higher expectations for herself than others, the goals she set for herself were primarily restricted to instructional practices or classroom management. She did not speak to learning specific mathematical content. This contrasts with Mary, who discussed her presumed inability to teach the upper level classes, and therefore, avoids teaching them; and also differs with Betty, who discussed her age-related limitations that kept her from learning more advanced content.

Motivation to Learn

Lucy did not provide a great deal of detail regarding why she wanted to learn. She wanted to be able to run things more smoothly in her classroom or keep up with her curriculum. She detailed that she was motivated to be an ongoing and adaptive learner.

> You wanna keep learning new things. You don't wanna just go, well OK. So, I've done my [graduate] school, so I'm done with that. And I don't need to learn anything else. I just need to keep teaching… I just don't want to be average. (Interview)

Lucy felt that she *ought* to be an ongoing learner. Although she began a graduate program prior to the beginning of the study, she ultimately took a sabbatical and did not return to the program. During a follow-up interview, Lucy revealed that when the summer began, she fell ill for approximately two weeks. She took the summer off from her graduate program to rest and focus on herself and her family. When the subsequent semester approached, she did not register for classes. Ultimately, she did not complete the graduate program.

With the exception of her graduate studies, most of the learning experiences that Lucy discussed during the interview were mandated or organized by authority figures. Through her entries on the Professional Learning Discussion Board, Lucy attributed many positive and negative learning experiences to authority figures who organized them.

> Not having a classroom was an incredible learning experience. It stunk, but it was very helpful. I would definitely describe it as informal, and I guess I can thank my boss for organizing it… The worst learning experiences are in the meetings that all teachers attend. I guess the county organizes those, I'm not sure… I have had the opportunity to attend a training (that's what THEY called it) that provided specialized content knowledge. The informal one, for me, I feel like is always specialized content, like asking a co-worker. I do this at least weekly. Of all the formal workshops I have been forced to go to, I think what I have gained are resources. (Blog Entry)

She took the initiative to ask for help when she needed it, but she also spotlighted the roles that both her department chair and her school district have in providing and mandating some of her professional learning experiences.

Methods of Learning

Lucy embraced a variety of learning experiences. During the time of the interview, she was enrolled in two graduate classes. She felt she was learning about technology that she could "hopefully" use in the future. For instance, in one class, she learned how to use Internet resources to create and share forms, spreadsheets, and word-processing documents.

> We *had* to use it… You kind of have to alter it from grad school… So, I'll take that information I got from there, but I'm gonna have to alter it a little just for myself. (Interview)

She also learns a great deal from her peers. Lucy discussed her experiences as a new teacher at Site 1, and the benefits of observing her peers through floating.

> Coming in as a new teacher, I'm set with this group and that, I mean, that's all they did was help me learn that year… Every group we've been in, I mean, I feel like I've developed or learned something from each person—and even teachers that I haven't taught with… just because I was in their classroom for the first two years… I just saw everyone's little ways of doing things and picked my favorite. (Laughs.) It was good, actually. It helped me keep organized. (Interview)

Lucy specifically discussed how observing her peers helped to improve her classroom management.

> Floating into a different classroom each period was great because I saw other teachers' styles of setup, how they ran things, and I could ask them for suggestions since I had another experienced teacher in the room with me. From this I learned different management styles and ways to collect homework, tardies, etc. I totally stole ideas I liked from certain teachers to incorporate in my classroom now. (Blog Entry)

When Lucy talked about learning from her peers, she spoke of either observing them through floating, asking questions weekly for subject-area help, or working with them once they had already been assigned to groups either for formal professional learning sessions or by her department chair when developing teaching teams. In one of her blog responses, she revealed a reluctance to ask for help. "I want to continue to get better at initiating those conversations and not be scared to ask others that I respect."

When presented with the idea of teaching a new content area for the first time, Lucy described her preferred methods to prepare for the course.

> I would probably see what needs to be covered. Even with the standards or asked someone that's done it. And then go through it myself to make sure I can do it… I'll just go Google it or go— probably to another book… I'll do that and make sure I've learned it… I mean, most of the time I'd have to ask and make sure, with someone who's taught it before… Then I would have to figure how I'm gonna to teach it! (Laughs) I would probably, you know, come up with some kind of schedule based on what's already been done. And then, go through. (Pauses to think). Yeah, I'd have to go through daily on that kind of stuff, but even before that, I'd have to sit down make sure I can do all the notes that I've done and make sure that

> make sense. And go through all the classwork or whatever it may be, and I'll have to make sure it was ready way before. (Interview)

What if she had to teach calculus? She said that she would have to go to a summer training to get certified to teach the Advanced Placement course. Then, she would want to "sit in and watch" a colleague teach the course every day. She would then adapt what she was observing with her own notes. "I mean, if they taught something that I didn't come up with or put in their notes, I would have to, I would probably include that to have that part of it" (Interview). For Lucy, figuring out how to teach a new course entails understanding the content, verifying her ability to do the mathematics, and developing notes for her students. During this process, she would seek online resources or consult her peers.

During the time of the study, Lucy taught a new applied mathematics course offered to 12th grade students. During the interview, Lucy discussed attending mandated professional learning sessions during which she was exposed to various instructional strategies and curriculum pacing suggestions for the new course. The professional learning sessions, a series of workshops in a nearby metropolitan city, took place during the first week of the previous summer. She reflected that she benefited primarily from the facilitators' suggestions on classroom management and organizing collaborative activities.

> There's [*sic*] some things that we did in the actual workshop as far as the content goes that I'd never seen before. So that is what I took from that. But most of it I had seen before, so it's more about how to group them and how to, you know, they don't have homework. (Interview)… They basically just gave us the teacher binder and went through it with us. They wanted to give us a feel for how the class should run. We tried to implement these ideas in our classroom this year, FAIL. (Blog Entry)

After trying the suggested classroom management techniques, Lucy evaluated the strategies using student feedback, and came to the conclusion that the strategies were ineffective for her students. Ultimately, she found the strategies difficult to actually implement in her classroom because "these kids have never experienced anything like that and they are just thrown into it" (Interview). She went on to explain during the interview that her students had attendance issues, "dropped down" into the course, or "barely made it there." When I asked her how she evaluated a strategy when she was trying something new, she indicated that she sought out student feedback.

> They'll let me know… You know, like with the packets, they were awesome last year, and this year the kids hated 'em… So we'd ask them. I guess you kinda get a vibe, whether it's good or bad. I don't know where that vibe comes from. (Interview)

Various human resources take a large part in Lucy's learning. Administrators and district personnel provided several professional learning opportunities. She turned to her peers to help her to learn and clarify content. She also valued opportunities in which she could observe her peers' instructional practices. She synthesized what she learned through her notes and practice problems. Finally, Lucy used student feedback to help her evaluate the effectiveness of new instructional strategies.

Positive and Negative Learning Experiences

On the discussion board, Lucy wrote about her favorite and least favorite learning experiences. Both of these experiences have already been discussed at great length in previous sections of Lucy's Professional Learning Profile. In summary, Lucy described her experience as a floating teacher as an "incredible learning experience," even though "it stunk." Specifically, she valued the experience because she floated into different classrooms each period and observed how teachers setup their rooms, how they "ran

things," and she could occasionally "asked them for suggestions." Unlike Betty who found floating to be a detriment to her learning because she did not have her classroom materials, Lucy found this experience helpful. She enjoyed seeing different classroom management techniques and learned from the variety of strategies for collecting homework and keeping records of tardy students.

> I totally stole ideas I liked from certain teachers to incorporate in my classroom now. Even though my learning had nothing to do with mathematical knowledge, learning to be a better teacher and efficient in those "housekeeping" tasks can give more time to help prepare for a lesson, or go ask your colleague about the specific content. (Blog Entry)

Lucy's least favorite professional learning experiences were those provided by her school district. She felt like the sessions were designed to fit everyone's needs and therefore did not meet anyone's needs at all. "Usually, I feel like they are trying to reach the 'lowest common denominator' in the group" (Blog Entry). During the interview, she described having to attend one district-provided professional learning session that ended up being over the same material as the state-mandated session that she had attended during the previous summer.

> The one that we had to go at the beginning of this year where I'd been through the training already, and then I had to go back and listen to the people that I had been in training with teach me the same thing. It was requirement, right? So I had to do it. And the leaders were in my training! (Interview)

When I asked her whether she would have attended even if the school district had not required her to go, she said she would have gone until she realized that she "didn't need to be there again because it was the same stuff." Therefore, Lucy felt that professional learning sessions mandated by her school district failed to meet her specific

learning needs, and she maintained that the content of this particular session just reiterated the content of the state-provided professional learning session.

Belief Systems

With respect to WWK (Belenky et al., 1986), Lucy's perspective of learning how to teach mathematics included examples of learning through both received knowing and subjective knowing. Lucy demonstrated characteristics of received knowing when she looked to her peers for guidance and ideas with classroom management. During the interview, she pointed out that one of her learning goals was to improve her classroom management techniques. During the interview, she pointed to her photograph of pacing charts and classroom binders to illustrate this professional learning interest. "Like assignments that they've missed, and… how to run your classroom effectively to make sure that you are meeting all the [students'] needs" (Interview).

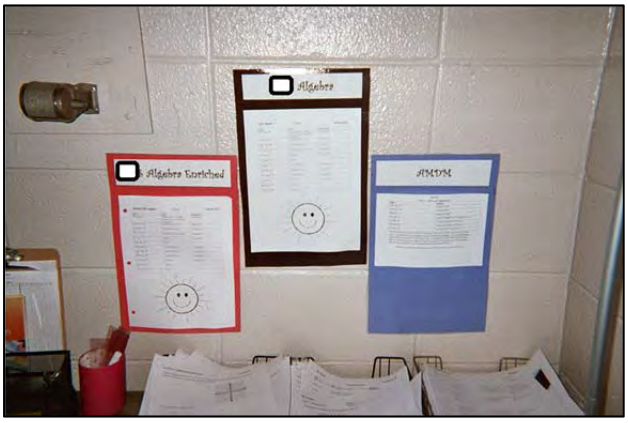

Figure 14. Lucy's Photograph of Class Calendars

Lucy expressed that her experience floating into other classrooms addressed this professional need in a positive way. "Floating into a different classroom each period was great because I saw other teachers' styles of setup, how they ran things, and I could ask them for suggestions" (Blog Entry). During the interview, she also stated that "I just saw

everyone's little ways of doing things and picked my favorite. (Laughs.) It was good, actually. It helped me keep organized." In both of these examples, Lucy expressed that she preferred to learn about classroom management techniques by observing other teachers. She did not collaborate with these teachers to develop new knowledge about classroom management. She observed her peers, and "stole ideas I liked from certain teachers to incorporate in my classroom now" (Blog Entry). She also liked the idea of peer coaching because the process embedded opportunities for teachers to observe each other. "I have never tried peer coaching and think it's a great idea. I think it would be more helpful for me to watch another teacher teach and then have them watch me teach, than for an administrator to come and watch me teach and offer suggestions" (Blog Entry).

However, Lucy also learned through a position of subjective knowing. She rationalized her perspectives by articulating her personal or intuitive thoughts. When I asked her to describe an expert mathematics teacher, she had a difficult time articulating her thoughts. "You need to constantly...to… a… like, share—what is the word? Like smooth edges, I guess. Like this didn't work this way, so next time we're going to change it… Reflect on the fact of what worked and what didn't and keep going from there" (Interview). When she described professional learning, she again struggled for her words, and indicated, "I *feel* like learning is new to you and developing is—crafting. If it's developing, it's like a constant thing" (Interview). She also used her intuition to evaluate the effectiveness of professional learning experiences. For instance, after Lucy attended the state- mandated professional learning sessions during the summer, she later implemented "housekeeping" strategies into her senior level mathematics course the

following school year. She noted that she evaluated the effectiveness of these strategies through seeking out student feedback. She asserted, “They’ll let me know… You kind get a vibe whether [the strategy] is good or bad. I don’t know where that vibe comes from” (Interview).

Lucy also recognized and sometimes used her voice (Belenky et al., 1986) to express herself to authority figures. Sometimes, she chose to echo the words of her peers. For example, on the Professional Learning Discussion Board, Lucy pointed to and agreed with Mary’s comments on the topic of mathematics-specific professional learning experiences.

> I totally agree with Mary on this one. I thought EVERYTHING she said was dead on. I think the formal opportunities provided to us are based on curriculum, which is good since it won’t ever stop changing… I have had the opportunity to attend a training (that’s what THEY called it) that provided specialized content knowledge. (Blog Entry)

In this example, Lucy used the words of another teacher to help her articulate and extend her thoughts. She also pointed out in another blog entry that she wanted to gain more confidence in asking for help from others. “I want to continue to get better at initiating those conversations and not be scared to ask others that I respect.” However, I found out in a follow-up interview that she did ask her department chair for help when she had reached a “breaking point.” Lucy described how she was made the 9th grade mathematics leader during the following school year. Toward the end of the first semester, Lucy stated that she told her department chair she was so unhappy at work that she did not even want to come to work the following day. Lucy said that her department chair told her to take two days off to rest, and that she would adjust schedules for the second semester so that Lucy would not have to work with the same people on her team

during the second semester. During the follow-up interview, Lucy also stated that after her discussion with her department chair, she "felt more comfortable going to [her department chair] if there was a problem. I feel like she'll listen to me now" (Follow-Up Interview).

Lucy's ideological perspective of teaching and learning mathematics was unclear. For example, much like an industrial trainer (Ernest, 1994), Lucy described learning to teach mathematics through referencing online resources, consulting books, and observing her peers. She explained that she would "go through" the curriculum with multiple references.

> Yeah, I'd have to go through daily on that kind of stuff… but even before that, I'd have to sit down make sure I can do all the notes that I've done and make sure that [they] make sense. And go through all the classwork or whatever it may be, and I'll have to make sure it was ready way before.

From this perspective, Lucy asserted that she learned how to teach mathematics through working through all the classwork. However, Lucy's acceptance of technology for practical uses in the classroom alluded to a more technological pragmatist perspective of teaching mathematics. She was concerned with how technology could be practically utilized to enhance her classroom management and organizational techniques. She did not profess that students should acquire mathematical skills in order to prepare them for real-life situations.

As she explained her technology-related photographs during the interview, Lucy stated that she wanted to learn "everything that's available for educators and how you could use it in the classroom… I use my cell phone every day in the classroom." Lucy pointed out that she used her phone to post homework answers to her class blog or to record the number of times her students were tardy. Lucy used technology as practical

tools for classroom management, and she wanted to learn more. She believed that "most learning occurs informally when you want to figure something out. You ask the appropriate questions and persons necessary to come to the correct conclusion" (Blog Entry). From this blog entry, Lucy hinted that she believed that there was a "correct conclusion," but also that learning occurs through problem solving. Further, she did not put expectations or limitations on what she believed her students were capable of accomplishing, other than pointing out during the interview that her senior students, who had poor attendance, struggled with her project-based mathematics class. In reference to the senior applied mathematics course, she claimed, "I don't know that it is created for the kids we have in there" (Interview).

Overall, even though the data did not support classifying Lucy's ideology of teaching and learning mathematics, she did posit a blended perspective of both the industrial trainer and the technological pragmatist with respect to learning how to teach mathematics. Ernest (1994) pointed out that industrial trainers believe that learning "depends on individual application, self-denial, and effort" (p. 148). Similar to the industrial trainer perspective, Lucy indicated that repetitive experiences of solving mathematics problems helped her to learn the mathematical content that she was teaching. Additionally, Lucy's professional learning desires revealed that she wanted to gain knowledge about using technology and classroom management tools so that she could integrate into her instructional practices. Lucy also valued being able to observe her peers' lessons so that she could then replicate those procedures within her own classroom. Although these perspectives of learning to teach mathematics developed through her interview, there was little evidence that she expected her students to learn

mathematics in the same way as she learned how to teach mathematics. For example, Lucy did not describe her students learning mathematics through repetitive exercises, nor did she indicate that she believed that students should learn mathematics in order to transfer that for practical means into a workforce. She also did not emphasize an "experimental view of learning" (Ernest, 1994, p. 163) that required students to have practical experiences. Within the contexts of her interview and within Lucy's responses on the Professional Learning Discussion Board, she rarely discussed how she viewed her students learning of mathematics. Although I did not ask her directly as to how she believed her students learned mathematics, I was surprised that Lucy did not discuss whether she felt her professional learning experiences did (or did not) impact how her students learned mathematics. She primarily discussed how her learning experiences influenced her practices, but not how changes to her practices influenced her students' learning. Therefore, there was not enough evidence to draw a definitive conclusion regarding Lucy's educational ideology because she did reveal a detailed account of her perspective of how students learn mathematics.

CHAPTER 8: HELEN'S PROFESSIONAL LEARNING PROFILE

Background

Helen had been teaching for nearly 23 years. She was African-American, married, with two college-aged children. Among all the participants, Helen had the most experience teaching at other, more diverse schools in the district. Specifically, Helen recalled leaving her previous school when the school had begun the process for becoming a magnet school. She disliked the division she believed existed between the staff and sought to work at another school that was closer to home. Helen transferred to Site 2 after Ed and Ellen encouraged her to transfer. Both of her children attended Site 2, and she found its location convenient for her because it was so close to home. Since coming to Site 2, she has taught Algebra, Geometry, and Advanced Algebra. During the time of the study, Helen taught 11th grade mathematics, which incorporated both advanced algebra and statistics topics.

Prior to teaching, Helen worked as a food chemist for five years. Her educational background included a Bachelor of Science degree in Chemistry, a Master of Education degree in Mathematics Education, and a state gifted endorsement. She taught summer school to offset expenses related to her children's college tuition. She also liked working with students who struggled with mathematics from all over her district. Although she wanted to retire within five years of the time of the study, she enjoyed teaching. After retirement, Helen intended to work as a mathematics tutor within her school district.

Photographs

Helen took three photographs that she related to professional learning. All of the pictures were taken in her classroom around her desk. The photographs featured not what she wanted to learn, but rather how she learned. Because there were so few pictures, I asked her to rank the photographs.

Her first-ranked photograph was of her desk and featured a closed three-ring binder containing class notes, a Statistics textbook, and an opened laptop displaying a website. A student sitting in the background appeared to be studying. When she described why she took the first picture, she explained, “It’s the combination. It’s the book, the computer, and just the work because I do a lot of research myself. That’s why I chose it as my first. That’s basically how I’ve been doing any of my learning” (Interview).

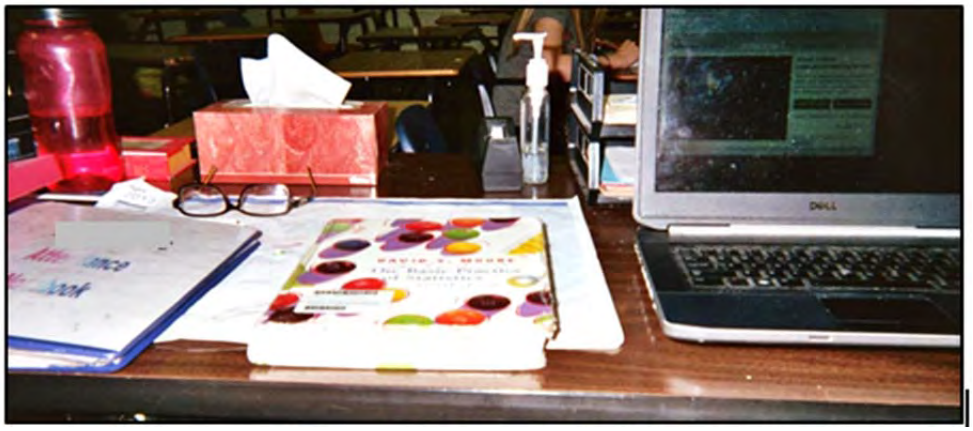

Figure 15. Helen’s Photograph of Her Notebook, Textbook, and Laptop

Her second photograph was of her cell phone, turned off and lying flat on her desk. She explained that her cell phone was her “way of texting, talking to teachers, the people when there’s not a body there that I can ask questions quickly. I get it on the phone” (Interview). As this reminded me of Lucy, whose cell phone photograph was linked to classroom management, I asked Helen whether she used her phone in the

classroom or with her students. “Not with the kids, no. No, they have to put their phones up. No, no. I use my phone *as a phone*” (Interview).

Finally, her third and final photograph contained an empty, blue armless chair positioned near a small desk containing a few papers and textbooks. This photograph struck me as lonely. When I asked her why she took that photo, she explained that was the tough part about not communicating with other people because “I’m having to, a lot of time, just get things on my own and playing by myself” (Interview). Although another person in her department was also teaching one of her subjects, Helen stated that she was the one who kept the content and the pacing of the course organized. “I’m making up all the tests and quizzes, where we should be sharing” (Interview).

Figure 16. Helen’s Photograph of an Empty Desk Chair

Although Helen discussed her photographs during the interview, I could not help but notice that she captured an isolated perspective of teaching. Unlike some of the other participants’ photographs, the human support systems and optimism for learning had been stripped away to reveal her realistic process of working independently.

Perspective of Learning and Teaching Mathematics

When Helen reflected about student learning and how it took place, she often compared her students at Site 2 to students at other schools in the district where she had worked. Her previous teaching experience included more diverse schools within the school district that were not categorized as "high performing," as were the sites within this study. However, her previous teaching sites developed or offered different educational programs, such as International Baccalaureate Curriculum, Science, Technology Engineering and Mathematics (STEM) curricula, or even magnet programs for mathematics and science. Helen's experiences at these others sites provided a backdrop for her to make connections and comparisons of her current students' learning needs with those her previous students at these other sites.

For example, as Helen talked about teaching summer school, she expressed that she values that experience, not just for the additional income, but also because she enjoys working with students from other schools.

> It gives me the opportunity to see more than the kids that are here, really. Um, I find myself touching kids from other schools. And that I like. And the kids will say, and I like being able to help them, and they go back, and they're oh, that's a teacher at [Site 2]. So that's how I get the good comments, when the bad ones come from when I have to prove myself every year… Doing the math is easy, it's something I enjoy, and it allows me to touch other kids, not just the [Site 2] children. (Interview)

Overall, Helen stated that students did not have enough time to learn mathematics with the new curriculum. Although she acknowledged that her students at Site 2 performed well on the standardized tests, she professed that they were not ready for college-level mathematics courses. For example, she asserted that before educational reforms, the curriculum allowed students to see some content more than once, allowing

students enough time and sufficient exposure to learn the content. However, she viewed the new curriculum as changing the spiraling process of learning.

> They're not getting it but one time here… And I see these kids here, and it hurts me… This year's the first year I'm sending a group of seniors out there... and these kids aren't solving anything. They can't solve equations. That hurts those of us who really want them to learn the math. They don't have to love it, but at least be able to do… I'm not even sure how many of them are going to be able to pass a college intro course. There's a big difference, isn't there? We've got good SAT scores, and a lot of them can afford to pay for the SAT courses, and I think a lot of them do that. But as far as their retaining, and being able to connect things? It's not there like it used to. (Interview)

In order for teachers to meet these educational concerns, Helen asserted that teachers should implement flexible instructional strategies to address educational gaps. During the interview, she provided examples of both student-centered and teacher-centered lessons. In one instance, she spoke of leading a class discussion by working out problems for her students while using a document camera. She preferred working out problems in class so that she can act surprised when her students discovered mathematical properties together.

> I always do everything fresh. I don't like just having these notes written down. PowerPoints are great… but I like to write it out, and let the kids see as we go along… Then sometimes going "Wow," acting like I just discovered it because they're just discovering it. (Interview)

During the semester when I interviewed Helen, she was teaching two classes, one of which she taught four times a day. Although the school provided class blogs for teachers to post links and class notes, Helen indicated she made posts to her blog to benefit the students' parents—not the students.

> My kids don't go to the blog. My blog basically tells—it is for the parents to let them know, um, what was going on that day. I don't even put worksheets and stuff or anything on there.… If we make it that convenient, then why are [students] coming to class? I write it five times,

> four times myself. And if a kid comes in, they know they can go to this pile, pull one of these copies, they can write down whatever they need, and they bring it back. (Interview)

Helen described herself as delivering the exact same notes to each of her class periods through this teacher-led discussion format. However, when she discussed how learning should take place for teachers, she described a very different image of learning.

> We should all be lifelong learners, and we're imparting knowledge to the kids. At all times, you should be learning. Whether it's a new way of doing something, or a new idea, or you're learning new material. You know, the overall concept, it's constantly doing… Whenever you get to a person who's doing the same thing over and over, the same way every time, it's stale and dead. (Interview)

Helen was open to her students learning through collaborative activities. For instance, during the interview (and later in a blog entry), Helen described modifying a collaborative activity with a colleague that helped her students make connections between trigonometric functions and their graphs. She allowed me to take a picture of her classroom Word Wall where she proudly displayed the student work from this activity (see Figure 17).

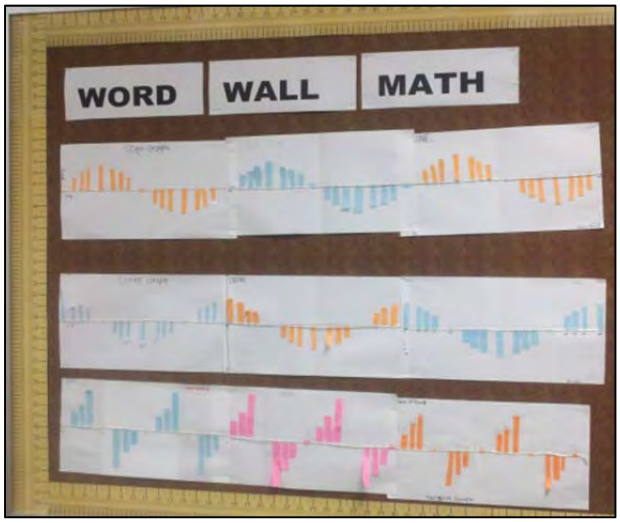

Figure 17. Researcher's Photograph of Helen's Bulletin Board

> It's supposed to be spaghetti, but we use paper, and when I started doing that, incorporating that activity in at the beginning and… we would stretch them all out across the room… I saw that making it more powerful. I saw the kids coming out of the room, like, "Oh, I know what that means now when you talk about the sine, and that's getting all of the y-values." … We talked about slope, and… I was putting them in groups of twos, and if I ran out of people… the loner person was the tangent… I had people… takers on the tangent. Cause you know you have a few competitive ones, and I want to do that one so I can show you how I can figure it out anyway. But that became to me a good example of enriching and improving the… teaching of the sine and cosine, starting the trig. And my kids loved that. They'd never done that before. (Interview)

Through her description of an expert mathematics teacher, Helen asserted that expert teachers are well-rounded in mathematics by knowing their subject well. She also thought expert mathematics teachers are observant of students' needs and flexible with students to "be able to regroup and give kids what they need and extract what they do know and then help fill in those gaps" (Interview). Helen pointed out that teachers needed to be flexible with students—not coddle them—in order to meet their needs.

> You gotta be listening enough and observant enough to be able to know when to push and when to pull back on a kid. Hit 'em hard, back off a little bit. That kinda thing. Those are what make to me, I see, as the skills a teacher does, a person that's just rigorous, coming in with their lesson in mind. Knowing exactly what they're going to teach, exactly what they want to get across, and they don't care what… it's going to be carried on, and they don't care who falls along the way. That's not good teaching. (Interview)

Helen associates flexibility with compassion, differentiation, and being attuned to students' immediate learning needs. More importantly, Helen pointed out that teachers should care about those students who fall behind. She described expert teachers as teachers who address the needs of their students through flexibility, content knowledge, and compassion. Does she think of herself as an expert mathematics teacher?

> Yes, I do… because of experience, what I just said to you… And it's taken years to do it. I've made some big mistakes in those first years… My

> situation's different. I came in from the industry. I was thirty-one-ish when I started. So I came in with experience from the industry. I came in with the fact that my husband and I worked with young people for a long time. Counseling. So I knew there was a thing of helping them, and not breaking their spirit. It's different, breaking a kid's spirit and just turning them off. (Interview)

Helen stated that her connections with and her concern for her students was a strength. She indicated that when she first began teaching, the most difficult aspect of the process was just acquiring the mathematical content knowledge for teaching. "It took maybe five years for me, of playing around with some things and getting the mathematics back under my belt… before I felt, okay, um, I'm getting a handle of this" (Interview). Helen also felt that her extensive experience in teaching allowed her to predict student misconceptions about mathematics and "structure meaningful lessons that will allow students to make connections and build for transfer" (Blog Entry). Given that, she believes that professional learning should help teachers develop instructional strategies to "challenge our young people to make connections and increase and strengthen the number of tools in their mathematical toolbox so that they may be able to think critically" (Blog Entry). However, Helen did not mention how deep or how broad the expert teacher's knowledge should be, or how they actually facilitated the learning process. Helen emphasized the student-teacher relationship as being paramount to the learning process, whereas other participants stressed knowing all the content, teaching strategies, or the promotion of problem-solving skills.

Professional Goals

During the interview, Helen explained that her strained relationships with her peers and her administration produced a context in which she felt she had to work independently. In turn, this stress influenced her professional short-term and long-term

goals. For one particular class, Helen was on a collaborative team with a new teacher who also was a coach. Although the course that they were teaching together was new for Helen, the other teacher had taught it a few times before. She pointed out that he had also taught non-Advanced Placement statistics and calculus courses. She explained:

> You know coaches. So, um, he gave me a few things, but he just handed stuff... but imparting it is another issue. To share with someone is— There are a number of people who are not team players, you know? It's not that he's not nice and everything, and he would, he was handing me things, but I don't think he's organized enough. (Interview)

Helen expected her teammate to contribute more to the planning of the course, partly because he taught more sections of the course than she taught that semester. "He should have been leading out because he had first period, I didn't. I made up all the units of everything. Everything, all year long" (Interview). Another ongoing issue was that Helen and her teammate were not giving the same assessments. "We would talk about the test and stuff, and his tests… were not of the same caliber." Helen went on to explain that tensions between her and her students' parents began to mount. "I got a lot of flack from the parents. 'You're too hard.'" Helen indicated that she tried to talk to her collaborating teacher and her department chair about the ongoing issues, but many of the issues remained unresolved. "I did not want to get into a thing with the parents" (Interview).

For several years, Helen had taught freshman mathematics courses. She expressed that as the only African-American in her department, she had to gain the trust and respect of her students' parents and her administration each year.

> It is hard here because I have to prove myself almost every year. With the… when we get a new administration, I have to start over again with the administration. Last year was a new administration. I had to start over again. And then, every year with the parents, if I'm teaching freshmen… They look… especially with the gifted certification and stuff, *that person's* teaching our kids? And you hear that, "that person." (Interview)

Although she cared about success of her students, she claimed that she was not as nurturing compared to the other same-subject area teacher.

> I'm, "Baby, get going," whereas she's the mothering, coddling type… Several of the parents, then the kids switched into her class from mine, because they felt that she was more nurturing… The kids' grades went down, because they needed someone on them, and several of the parents came back and said, "We thought, we really thought it was the teacher, and now we know it wasn't. It was our child."… I got a few cards back from parents, that very first year we started the new curriculum, that said, "We're sorry." (Interview)

Helen described this year of her teaching as a "really bad year" (Interview). She suggested that parents mounted complaints against her that snowballed into a few tense conferences between her, her assistant principal, and principal. She pointed out that she had to "be real careful with my administration" (Interview). Then, she detailed the experience.

> They came after me with a vengeance. I'm over fifty… I think they thought they were cleaning house. It seems like… I was teaching the [the gifted freshman course] with [another teacher], who just came in… and, the parents out here… will lie at the drop of a hat. And, they will go after you. (Interview)

Helen noted that the assistant principal was already angry with her for questioning her judgment on a previous complaint. The assistant principal approached her with a parental complaint accusing Helen of answering a student's question with the phrase, "I'll answer that question if you really want me to" (Interview). Perplexed, Helen asked what the administrator needed from her, and the administrator responded, "It's not what you said. It's how you said it." Helen asked her, "How do *you* know how I said it? Were you there?" Sensing that the administrator was becoming angry, Helen then asked if she had asked the parent to contact her first. Helen felt this made the administrator angrier.

> [T]heir response is first to please the parents. This is from the middle school mentality… She said this, "Yes, I tell them to talk to the teacher, but, um, if they want to talk to me, I let them talk to me." And I said, "Okay," and then she looked at me and said, "I'm so glad you're confident of yourself." And that was what came out. And I went, "Oh, let me back down." But I'd already hit her the wrong way. So she was out for me. After that. And so, anytime a complaint, it just snowballed and went on and on and on… and she started feeding stuff to the principal, and then the next thing I know, he and her [*sic*] came in… They started getting complaints and then finally, um, the principal, and the administrator who is over mathematics came in to see me, said that we're getting multiple complaints that I was not approachable, and that I was answering the kids' questions with questions. And I was like, "Are y'all for real? Um, aren't we supposed to ask them questions to help them… think critically?" … I wasn't very meek and mild because I was really teed off at this point… I asked, um, if you knew me, you would have responded to those parents, "First of all, my teachers here are here to teach kids. They are here… they are not here to hurt kids, they are here to help kids." … I'm having a problem with understanding you guys just quickly jumping on this bandwagon that I am doing something wrong… The principal basically said to me, if the complaints did not decrease, I was actually going to be put on the PDP. (Interview)

Helen persistently asked the administrators for specific feedback on what she was doing wrong, and she also wanted to know who was making the complaints. When the principals protected the anonymity of the complainers, she asserted that they were allowing parents to "slander and say anything they want about you… with no recourse" (Interview). Although she thought that some of the complaints were racially motivated, Helen assert that because she was teaching an honors-level freshman course in which every student was not making an A, the parents were just frustrated.

> So you got this black woman here telling me, my child is not making this A, you know, and we've been paying all this tutoring and this stuff. And you've got this person saying my child is not accelerated. Which I didn't say they weren't accelerated, it's just that they weren't performing… So I think some of it is racially motivated. I think some of it was comparing the two teachers. (Interview)

Helen believed that the parents in the community were very influential over the administration. She stated that if parents complained, they bypassed the department chair to speak directly with the principal. There had been several administrators at Site 2 since Helen started teaching there. She recalled the first (and only) African-American principal at Site 2, and how he was received by the community.

> He was the first black principal that [Site 2] has ever had. They called a faculty meeting to tell us we were getting this new principal… and then the person from the county office… said his name… A few of us who are black here, were like, "He black." And they said, the next word that came out his mouth was, "He is well-spoken." And we said, "He's definitely black." So we just laughed. We knew. And when he came in, all the money around here dried up. We get a lot of, um, according to the last principal, we're getting a lot of donors that are giving money. That's how we got that jumbotron out there… It was hard to get things going… He brought in a number of minorities. African-Americans, there were some Asians… teachers, staff. It was becoming more multi-cultural… We had one black counselor at that point. And then he brought in another, so we had two black counselors at one point, and they started having a black history month. Well… we had an assembly, and so the national anthem was sung, and then we did the National Black Anthem. Don't you know there was a stink about that? [The administrator] was like, "I don't believe these people." I just started laughing, and said welcome to [Site 2's area]. Then they said he was not the right "flavor" for this area. (Interview)

Helen asserted that this comment came from the community. So, this African-American principal was promoted, and a new, white "clean-cut" (Interview) administrator was hired. Helen indicated that he appeared to be "cleaning house," causing the money to pour in from the community again.

> He got rid of basically almost all the African-Americans, almost all the minorities in one way or another. Got… they either got transferred, or they requested a transfer to leave, because of getting bullied or whatever… And then another side of things, and then the money started pouring back. (Interview)

Among all of Helen's examples of racial tensions at Site 2, she consistently spoke of her students in a positive light. In spite of hearing faculty members make racist

comments or feeling attacked by her administration and students' parents, Helen maintained that she loved teaching and helping her students to learn mathematics. During the interview, I asked her whether she liked teaching at Site 2. Helen responded that the location was five minutes from her home; however, her most enjoyable place to work was her previous school, which had a diverse high school population. Unlike Site 2, that school was developing a mathematics and science magnet program. "It wasn't as, um, taxing, as far as on me. I felt… first of all, there were a lot of ethnicities there. There were so many. The mathematics department was very… tightly knit. More so than here" (Interview). The other school also did not have the same level of pressure on the students and faculty. "It was a lot more laid back... and there was more of an appreciation. Parents really loved you. I mean I get parents who love me here too… They really appreciated you. People smiled. There are days around here, where it gets really high strung" (Interview).

For the most part, she expressed that she felt more valued at her previous school. She acknowledged that at Site 2 she felt "valued by those that count" (Interview) in her department, whom she described as her "inner circle of influence" (Interview) that encourage and support her. For her this support "goes a long way" (Interview).

During the interview, I asked Helen about her short-term and long-term goals. She responded that she wanted to learn calculus for herself and to be able to help former students who still come to her for help. Learning this content knowledge was her long-term goal. What about short term? "I'm just trying to get through this year, girl. Short-term, let's get through this year right now. Yeah, and I have a final exam and a test that I have to make up all by myself… I can, I can make it my next six years" (Interview).

Unfortunately, Helen revealed in a follow-up conference that the subsequent school year had become much more difficult. Becoming more concerned about the relationship between herself and her administration, she asked me if I had shared her interview with anyone at her school because they appeared “out to get” her (Follow-Up Interview). I assured her that our conversation was confidential, and that I was still analyzing the data. When I offered to let her bow out of the study, she maintained that she wanted her story to be heard. However, she indicated that she was working more in isolation than the previous semester when I had interviewed her. She described how her administration had changed her teaching schedule one week prior to the first week of school. Helen was told that she would be teaching one new course completely by herself four times a day, and another course on-line. She pointed out that she did not have any support. When Ed, her department chair, asked the principal on her behalf about the change, the administrator gave him no explanation. During the time of the follow-up interview, Helen asserted that the new school year had begun to take a toll on her. “I’m really tired. I don’t feel valued or respected.” She went on to describe that during the first month of the school year, she vomited everyday due to stress and anxiety. She was teaching the alternative course for seniors four times a day. Helen explained, “I’m not defined by what I teach, but they scheduled me to teach the lowest of the low all day long. It’s almost as if he’s trying to break me… Everyone’s afraid for their job so that they don’t want to stick their neck out for me” (Follow-Up Interview). As parental complaints continued, Helen posited that her principal was only concerned about pleasing the parents. Despite her rough year, she said that she still loved teaching. Helen asserted that she just did not want to be a babysitter, nor did she want to give away good grades

just to placate parents. In light of these circumstances, Helen was looking to transfer to a different school, and take her complaints to the superintendent of her school district.

Despite her struggles, Helen maintained that she loved teaching, and she still wanted to learn. Most of her goals addressed her immediate need for deepening her content knowledge. When I interviewed Helen, she was teaching 11th grade mathematics, and this course included a section of statistics that she had not taught before. In order to prepare, she "ate, slept, and breathed" (Interview) statistics for approximately three weeks. In addition to learning statistics, she was concurrently "stretching" herself by trying to learn calculus. "A lot of the kids come to me for the calculus… I'd been working on the calculus for myself, and I was sitting in on [a colleague's] class trying to get it back in my head… I actually did it for myself because I know, eventually, I'm going to be retiring. Supposedly in six years, and I will probably be tutoring" (Interview). She was tutoring at the time of the study, and many of the students were getting older. She hoped to learn calculus so that she could help these students, but she was also learning it for herself. "I love math, so this is my thing. I wanted to get the calculus back under my own belt, for myself" (Interview).

Helen uniquely discussed wanting to learn new mathematical content specifically for her students or for herself. Although Helen did not "feel valued" (Interview) by many people in her department, she expressed that her students needed her. In that regard, her motivation to learn content is twofold. She focused on learning immediate knowledge for her students that she had in class during the time of the study, as well as additional content knowledge to support her as she tutored students. When I asked Helen who developed her learning goals, she pointed to herself and responded, "Me. Yeah. Oh yeah,

there's no one to tell you.… I'm probably my worst critic, and my best critic too, in my opinion" (Interview). The obstacle that got in the way of her achieving her goals was time.

> I'm up extremely late at night. Um, I fall asleep, but that's how it goes. It's, uh… yeah, time. I tend to not let things get totally in the way. I get things done… Unfortunately it's a detriment to my health sometimes. Sorry. I'm getting better. (Interview)

Beyond content, Helen was also interested in learning how to use various types of technology that were accessible to her at Site 2. Although she was interested in mathematical software programs, such as Geometer's Sketchpad or Fathom, she was not sure how she could integrate them into her current classes. "If I was going to be doing the geometry, maybe seeing some ways you can incorporate it into the algebraic concepts, if that's what I'm doing" (Interview). Accessibility also posed a problem. Although she used a document camera in her class, she pointed out that her classroom still had a chalk board, and that she did not have access to the class-set of portable computers on a cart. "I would love to have… be able to learn.... We don't have SmartBoards. I would love to if I had one, but *don't* show it to me now while I don't have one."

In summary, Helen was most interested in learning mathematical content to enhance her immediate knowledge for teaching and tutoring. She expressed that she was the sole creator of materials, pacing guides, and assessments, and most importantly, she needed to know what she was teaching prior to developing these materials. Helen learned to survive within the context that was handed to her. Helen taught a new class with a peer whom she believed was reluctant to collaborate. Helen asserted that surviving the school year meant independently creating assignments, learning content, and planning out the curriculum unit by unit. Although she asserted that she cared for her students, she did not

speak to how she interacted with her students in class. She talked about wanting to learn the content so that she can tutor them.

> We must create the structures and cultures that embed collaboration in the routine practice of our schools, ensure that the collaborative efforts focus on the right work and support educators as they build their capacity to work together rather than alone. I am convinced that when we experience the powerful benefits of working together verses working alone then collaboration becomes a priority instead of a chore. (Blog Entry)

Motivation to Learn

Regardless of the numerous negative experiences with faculty members, parents, and her administration, Helen maintained that she was motivated to be the best teacher she could be for her students. Her primary learning goal centered on enhancing her mathematical content knowledge, such as statistics and calculus, because she wanted to help her current and former students who needed and valued her expertise. During the follow-up interview, Helen lamented:

> I'm not bitter anymore. It is what it is. Life is going to happen. Ten percent of it is experience. Ninety percent of it is how you respond to that ten percent. No matter what's done and said, I'm going to continue to be professional and do my best job with the kids.

Helen taught her own students, her former students, students with disabilities through a tutoring firm, and students from low-performing schools through summer school. Although she was discouraged from working relationships, she asserted that "I want to do what's best for my kids, and that's my driving force." Overall, she declared that it was her personal mission to model lifetime learning to her students.

Methods of Learning

Helen asserted that she learned independently either because she was teaching a course by herself or because her team members refused to collaborate with her. As a self-

identified “loner” (Interview), she admitted that it was not an ideal circumstance for professional learning; yet, it was necessary. Why does she call herself a loner?

> You’re having to do everything by yourself, come up with, even the train of thought, how you’re going to grade it, or all that’s based on yourself, then you have to sit and justify how you’ve done it versus somebody else. So that’s a loner. And I’m like that twenty-four/seven around here now… It’s not the ideal situation to always do, but yeah, you can get stuff learned. Definitely. (Interview)

As Helen focused on learning mathematical content and developing materials for her courses, she turned to textbooks and online resources. Her photographs and photograph descriptions captured this process.

> Observing and conversing with respected peers, Internet explanations from reputable websites, research from multiple book sources, and telephone conversations with other peers are some of the ways I learn new concepts. (Blog Entry)

During the interview, she explained that she took a photograph of the computer, textbook, and notebook binder because she used all three the resources as she learned to teach statistics.

> It’s the combination. It’s the book, the computer, and just the work, because I do a lot of research myself. So that’s why I chose it as my first [photograph to discuss.] That’s basically how I’ve been doing any of my learning has been Internet, in the book, and stat [statistics] was new for me. (Interview)

Figure 18. Helen’s Photograph of her Notebook, Textbook, and Laptop

She also sought out help from her colleague at Site 2 that taught Advanced Placement (AP) Statistics. “She’s our AP Stat guru” (Interview). She also used her cell phone to call a friend at another school in the district who was also teaching AP Statistics.

> During my spring break, that’s when I started on the stat stuff, just learning for myself, writing out my questions, coming in and asking [the department Stat guru]. Looking through and calling [another peer] up, and she was like my right hand person who taught AP Stat at [another school in the school district]… So she was filtering me things that she was doing, and I tweaked. (Interview)

Helen mentioned repeatedly that she felt that she was developing materials for her courses by herself, yet she was still quite resourceful in finding other mathematics teachers who could answer her questions or give her materials to help her get started. Although the process was not ideal, Helen believed it was necessary given her circumstances. “You know, but there’s so many things that you can pull in there with you, so you’re not really alone. Yes! It’s not really *alone*” (Interview). Helen goes on to suggest during the interview that teachers were loners when they shut their doors to collaboration and “don’t take into consideration anyone else… To me, that’s more detrimental than to say I’m learning the material.” Helen also observes her peers in order to learn the subject-specific content. On the blog, she stated that she constantly used peer coaching. “I try to observe colleagues and glean insight to aid in presenting content to my students.” To substantiate this statement, she alluded during her interview to her presence in Laura’s calculus classes a few times to learn calculus. Although she sought out the help and guidance of others, she also referred to her colleagues to clarify her knowledge, fill in gaps, or receive materials for the course. She spoke of learning or gaining something *from* them—not with them.

Initially, she turned to books and her colleagues that taught calculus. However, as she started approaching her colleagues for more help, she noticed that students were attending the help sessions as well. “I can’t get in [to ask the calculus teacher questions] because kids are needing help, and then I’m behind... so I thought, ‘Okay, let me just do it on my own. Then I’ll just go to them as I need help.’ So that’s how it’s been going” (Interview). When she did need the help, she contacted her colleagues over the phone.

> I get on the phone. Or I’ll write down the question, and I’ll say, “Okay, I have to get back to you one this... But most of the time I’ve been successful because the kids, the problems that they’re having on the algebraic stuff, which I can do, then putting things together, and I can put it together. Or I’ll say, “Where are your notes?” And we’ll look at their notes, and I can kinda tweak, and go okay, now I understand, and I’ll pick up the book. So I’ve been doing it that way. It’s hard, but it’s fun, and, you know, that’s how I get it. (Interview)

Her process of learning calculus was messy, but she used both books and sought out help from both teachers and students throughout the process. She evaluated her learning process as effective depending on whether ultimately she “gets it” (Interview). Helen wanted to understand the calculus in order to help her former students that sought her out for tutoring.

Helen greatly relied upon herself as an independent learner in order to learn mathematical content and develop her course materials. For this reason, Helen embraced the idea of online learning. She mentioned during the interview that she would “love to take some Internet courses.” She appreciated the independence and flexibility offered through online learning. “I can adapt it into my schedule… I’m not one who has to have someone over me, so I can follow very easily and pace things for myself” (Interview). In addition to online learning, Helen also stated that earning gifted endorsements allowed teachers to “study extensively about the different learners and how to effectively

differentiate the lessons" (Blog Entry). In a blog post, she revealed that, after implementing a lesson, she self-reflected and sometimes asked "trusted colleagues to observe and critique my presentation." Keeping a reflective journal allowed Helen to consider her delivery and deepen her understanding of the material.

Helen immersed herself in the subject she was learning. She consulted the book, the Internet, a department friend whom she considers an expert, and even called on other friends outside of Site 2 for help. I experienced this myself with follow-up interactions with Helen. At the beginning of the following school year, she found herself teaching another subject for the first time, which she also planned by herself. When she realized that I was teaching a similar subject, she sought out my help as well. She called me and emailed me to seek out additional resources such as tests, assignments, or pacing charts. In a short email, she wrote, "Hope your semester went well. Is it possible that I can meet you and give you a jump stick to get any files you have on units 4-6? Anything you can do will be appreciated" (Follow-Up Email). When I did not respond immediately, she left me a voicemail stating that she was "flying blind," and that any help I could give her would be appreciated. When I later followed-up with her, we talked about pacing and curriculum order, and I emailed her some of my homework calendars to help her get started. She gratefully replied that the advice was helpful, and she was going to try the sequencing I suggested. She just needed a plan.

Helen's cell phone was the metaphorical lifeline she used when she felt as if she was drowning. She called her peers to get the help she needed. Unlike Lucy, who used her phone as a tool for classroom management, Helen used her phone as a networking tool in order to reach out to others. Helen also used it to collect resources from a variety

of people and places from within her school district. Her networking pool of human resources was therefore extended beyond the walls of her classroom and school. She was branching out to other human and material resources. Although she was a self-professed "loner" (Interview), she also stated that embedded collaborative structures "support educators as they build their capacity to work together rather than alone." She believed that when educators "experience the powerful benefits of working together verses working alone" (Blog Entry), collaborating became less of a chore and more of a priority.

Positive and Negative Learning Experiences

The most positive learning experience that Helen discussed was working with a peer to develop an activity for her students. This experience was so meaningful to her that she brought it up during the interview and wrote about it on the Professional Learning Discussion Board. She wrote:

> My best experience, which was informal, has come out of a need to do something differently. When asked, one of my colleagues showed me how to use the spaghetti noodles which after time we modified to colored paper strips to create a concrete model of sine, cosine, and tangent graphs. Since I have been using this activity, students always come away with a better understanding of how the sine, cosine, and tangent values of the unit circle are derived. I look forward to introducing this activity as a visual connection between the sine, cosine, and tangent values and the unit circle each time I teach the unit. (Blog Entry)

This example illustrates that although Helen found herself developing most of her course content independently, she still desired and valued working with her colleagues. Additionally, she also listened to her students' input in order to evaluate the effectiveness of the implemented strategy.

When Helen described negative learning experiences, she discussed having to attend an in-service that her school district provided. She wrote in a blog post that the

workshop provided during the in-service was “so generalized and more often than not information that would benefit a first-year teacher instead of a veteran.” As a result, she indicated that she would have rather worked at “my school with colleagues preparing for the opening of the school year.” During the interview, she described another “really bad” school district workshop in which the speaker addressed a group of teachers with information that “you don’t need.” Lunch-and-learns, Helen pointed out, can be equally irrelevant.

> Whenever they tell you to have these lunch-and-learn type things, people come, and they eat lunch, and they ain’t learning anything. You’re just eating lunch, and you’re listening to this person present. And nobody goes back and looks at the stuff because you don’t have time anyway. So it’s not relevant stuff. I mean, a lot of times it’s not relevant. (Interview)

Therefore, Helen valued learning experiences in which she felt she could learn from her peers and immediately use or implement the learned information. In contrast, Helen disliked the mandated professional learning opportunities provided by either at her administrators or school district because they did not address her learning needs. For these instances, she dubbed the experiences as “a waste of time” (Interview).

Belief Systems

Hurtado (1996) offered the subjugated position as an extension of WWK (Belenky et al., 1986). As Helen described her perspective of teaching, learning, and professional learning, she provided several examples that illustrated the subjugated knowing position. Specifically, Helen discussed or wrote examples of Hurtado’s mechanisms of multiple identities, anger, silence, outspokenness (talking back), and withdrawal. During the time of the interview, Helen was teaching a new course with one other colleague. Her colleague was new and coached; because he had more sections of

the particular class, Helen felt that he should have been more of a team-player and collaborated with her. However, that did not happen. She explained that he would not consistently share and he just was not organized enough. Therefore, she ended up creating most of the materials for the course throughout the year. Although she felt that women could multitask, she felt that his unwillingness to collaborate was due to "ego" and that it was a "white male thing" (Interview).

Helen asserted that, as a black woman, she had to repeatedly prove herself each year to her students, their parents, and her administrators. During the time of the study, Helen expressed that her administrators put a great deal of pressure on her to change her "unapproachable" classroom persona that some parents complained about (Interview). When an administrator confronted Helen in her classroom after school, Helen became angry about the allegations and spoke up for herself. At first, Helen asked the administrator whether she prompted the complaining parents to contact Helen directly. Apparently, Helen's administrators had approached her to explain that several parents had complained, calling her unapproachable. Specifically, they argued that Helen answered students' questions with questions. "I was like, 'Are y'all for real? Um, aren't we supposed to ask them questions to help them become, to help them think critically?'… I wasn't very meek and mild, because I was really teed off at this point."

She asserted to her administrators that if they knew Helen, they would have responded to the complaining parents by saying, "My teachers are here to teach kids. They… are not here to hurt kids. They are here to help kids" (Interview). Because the administration did not defend her to the accusing parents, she told her administrators that she had "a problem with understanding you guys just quickly jumping on this band

wagon that I am doing something wrong." Helen became angrier when the principal threatened to put her on a Professional Development Plan (PDP) if the complaints did not subside. She pointed out that she believed it was unfair for parents to be given anonymity because they were allowed to "slander, and say anything about you" (Interview). During moments like this, Helen stuck up for herself and caught her administration's attention. Helen explained that when she asked her administrator whether or not the parents had been instructed to speak with Helen directly, "she looked at me and said, 'I'm so glad you're confident of yourself.' And that was what came out. And I went, 'Oh, let me back down.' But I'd already hit her the wrong way" (Interview).

Needless to say, Helen implied that she did not fit in with her faculty. She noted that she was the "first [African-American] in the math department, totally… Ever" (Interview). Helen also described using the mechanism of silence, or listening to others when she was in the minority in one context, and relaying what she had learned with people from her own community. This happened during a faculty meeting during which a new African-American principal was introduced to Site 2's faculty. Helen indicated that she was sitting with a few of the African-American faculty members on staff, and that they were discussing their interpretations of the principal's introduction within their smaller social circle. As previously detailed in this Helen's profile, she described during her interview that when her school's new, black principal was described as "well spoken" by white faculty members, and she and "a few of us who are black here" knew that he was African-American. She indicated that "We knew" (Interview). Helen's self-described behavior during this faculty meeting provided evidence that she remained silent while listening to and interpreting the statements of the Caucasian district personnel who

introduced the new principal. Meanwhile, within the subgroup of the faculty, Helen communicated about the racial identity of the new principal within the comfortable community of African-American faculty members.

However, Helen maintained another identity (i.e., multiple identities) outside of school. Helen explained that although she was in a minority in her workplace and in most places in the community, she chose to go to a church in which she was not in the minority.

> The church that we go to is a predominantly black church. I've said if… I'm the minority at work, I'm the minority when I go to the grocery store, I'm the minority every place, I'm not going to be the minority in my church. (Interview)

In many ways, Helen revealed that being in the minority was painful. She heard faculty members make racist comments about African-Americans, and she felt her school's atmosphere change during the presidential race.

> Certain comments are made. When Obama became president, around here, it was cold as ice. And it hurts. And you even heard people making comments and stuff like that. And you still… and I still hear the "n-word" said at times. I hear "monkey" at times. (Interview)

Helen's educational context was negative, accusatory, and isolating. When learning professionally, she withdrew and worked in isolation. However, she noted that she was not really alone, because she had access to other colleagues outside of Site 2 and plenty of resources on the computer.

Among all the ideologies, Helen mostly leans towards the old humanist (Ernest, 1994) view of teaching and learning mathematics. Her view of educational community was elitist and class stratified. On one of her free-response survey items, she described

Figure 19. Helen's Photograph of an Empty Desk Chair

her school as "white, [regional term for her area that implied it was elitist], parental dominance" (Survey Response).

During the interview, when she spoke of teaching mathematics, she highlighted implementing an activity that helped students understand the relationship between trigonometric functions and their graphs. In a blog entry, she pointed out that after using the activity, "students always come away with a better understanding of how the sine, cosine, and tangent values of the unit circle are derived." Helen also spoke about writing class notes for all of her classes by using a document camera and acting as though she were "discovering" the properties with them (Interview). These examples illustrate that Helen emphasized "understanding and application" while also "transmitting" a body of mathematical knowledge to her students through class notes (Ernest, 1994). Additionally, she appreciated mathematics for the body of structured, pure knowledge, as she was trying to teach herself calculus so that she could help her students. "I've been stretching as I've been trying to get the calculus back, because the kids, a lot of the kids come to me for the calculus" (Interview). Although she confessed that she was not a coddler, she tried

to encourage and motivate her students by being accessible for extra help, even if she was no longer their mathematics teacher.

CHAPTER 9: LAURA'S PROFESSIONAL LEARNING PROFILE

Background

Laura, who was Caucasian and 46-years-old at the time of the study, was married with two children. One of her children was college-aged and her other child still attended high school. Although her husband earned nearly three times her teacher's salary, she hoped to continue teaching for at least another 10 years. Prior to teaching mathematics, she worked as a mechanical engineer for 10 years. As an undergraduate, she earned a degree in Architectural Engineering, and later earned a Masters of Education in Mathematics Education.

Laura's nine years of teaching experience was solely at Site 2. Having earned a gifted teaching endorsement and an AP Calculus training, she was teaching AP Calculus and honors 10^{th} grade mathematics during the time of the study. In addition to teaching, she also coached a spring sport and Math Team.

Photographs

I supplied Laura with a disposable camera, but she preferred to use her personal digital camera to take her photographs. She submitted eight different photographs that captured her perspective of why teachers learn, how teachers learn, and her philosophy on professional learning. Prior to the interview, I asked her to choose five photos to discuss; however, as the interview unfolded, we ended up discussing them all. Laura's first photograph highlighted a bookcase containing four vertical columns piled high with mathematical textbooks, workbooks, and resources. She pointed out that with so many

available resources, the process of learning can be overwhelming and unguided. The second photograph that Laura discussed framed a school hallway adorned with student posters and lined with open and closed classroom doors. The open and closed doors symbolically represented teachers' willingness to be open and accessible for collaboration and support. Laura's third photograph displayed five calculators lined up side by side, ranging from a scientific calculator to basic graphing calculators and finally with the "latest and greatest" (Interview) colored TI Inspire. Laura explained that teachers kept "building [their] toolbox" as technology evolves. She expressed that teachers should not throw away old technology because they should become knowledgeable of all the tools that are accessible to both students and teachers.

Her fourth photograph was an image of the CollegeBoard.org website featuring the AP Central heading. With this photograph, she pointed out that educators sometimes have to seek out professional learning independently in order to meet state requirements of professional certifications. Laura's fifth, sixth, seventh, and eight photographs captured mathematical or motivational signs or posters within her workplace and classroom. One photograph displayed a sign posted in her mathematics department workroom: "If a student can't learn the way we teach, then let's teach them in a way that they <u>can</u> learn." Another picture showcased one of her classroom walls that contained 24 character building posters, indicating that "we have to evolve… So I took that picture because it's like the inspiration of why we… have to constantly be learning" (Interview).

Addressing self-accountability for learning, Laura took a photograph of a wide poster in the hallway of the mathematics department that read: "You are Responsible for You." The last photograph that Laura discussed during the interview was of a poster

featuring a table of mathematical standards and with columns of careers that apply the mathematical topics discussed in class. The title of the poster read, “When are we ever gonna have to use this?” Laura indicated that as a former engineer, it was important to her to help her students understand where and how they can use mathematics in the real world. Laura pointed out that other teachers may not have her engineering background, and she posited that professional learning should support mathematics teachers who may have a “hard time making those connections” (Interview).

Perspective of Learning and Teaching Mathematics

Through her interview, blog posts, pictures, and reflective journal responses, Laura detailed her perspectives on both student and teacher learning. More than any other participant, Laura was extraordinarily interested in motivation. She believed that one of the most difficult aspects of teaching mathematics was “getting the students to buy in to learning” (Interview).

> I think, unfortunately, as students, the joy of learning just doesn’t really exist… If you can get the students to… go from… “I'm required to be here. It’s mundane. It’s task oriented. Agh!” … to “I’m glad I’m here, and hey, I learned something new today. And hey, it’s kind of cool.” … Just getting them to buy in. Finding, finding that balance in teaching the skills. You know, the nuts and bolts of that they really need to be making, the connections and—is difficult. (Interview)

Laura admitted that keeping students motivated to learn was challenging. “It's just exhausting to be motivational 100% of the time” (Interview). How did her pedagogical emphasis on student motivation influence her perspectives of an expert mathematics teacher? Laura believed that expert teachers held high expectations for their students, taught a rigorous curriculum, and engaged students to promote an enjoyable learning process. She also jested that expert teachers did not “get much sleep.” She stated that

expert teachers motivate students to be dedicated to their own learning. This is what she seems to struggle with the most. “I would tend to say somebody that can deliver the content, uphold their standard as far as we’re not watering it down. This is, you know, sticking to their standard, and be able to do it so that it’s enjoyable for all” (Interview).

Although Laura felt that her students were “capable students,” she did not feel that they were dedicated to their own learning. In turn, she indicated that it was her job to convince her students to get them to buy into the learning process. “So it’s hard to be that motivational person day in and day out, day in, day out… It’s exhausting” (Interview). From a parental perspective, she lamented that more of the “highly successful” (Interview) teachers at Site 2 do not have school-aged children. I then asked her during the interview whether she believed there were excellent teachers who found a balance between teaching and parenting. “I think they do. Just not as many.”

Based on this description, Laura asserted during the interview that she was “partially” an expert mathematics teacher. She pointed out that her teaching strengths included maintaining the rigor of course and having high expectations for her students. However, she stated that one of her weaknesses was that she became frustrated when her “capable, but undedicated” (Interview) students did not meet her expectations. “I’ve got high expectations. I tend to show too much emotions when kids don’t meet my expectations” (Interview).

Laura suggested that expert mathematics teachers were open communicators. In one response to an article in the Professional Learning Journal, Laura wrote, “Since the title of this article was ‘Exemplary Teacher Voices,’ it implies that the ‘voice’ should be shared. When I think of teachers I would consider ‘exemplary’ at my school,

communication is always genuine and two-way." Other participants in the study emphasized that expert mathematics teachers have strong content knowledge, effective instructional strategies, differentiate, and/or are organized; however, Laura underscored that expert mathematics teachers are communicators and sharers of knowledge. Simply put, Laura's view extended expert teachers' communicative skills from the classroom into the workplace to include their peers. She valued collaboration and communication with her peers, yet she pointed out that members of her department were disconnected in their philosophies of how and when collaboration should take place. Laura explained her position by discussing the following photograph during her interview.

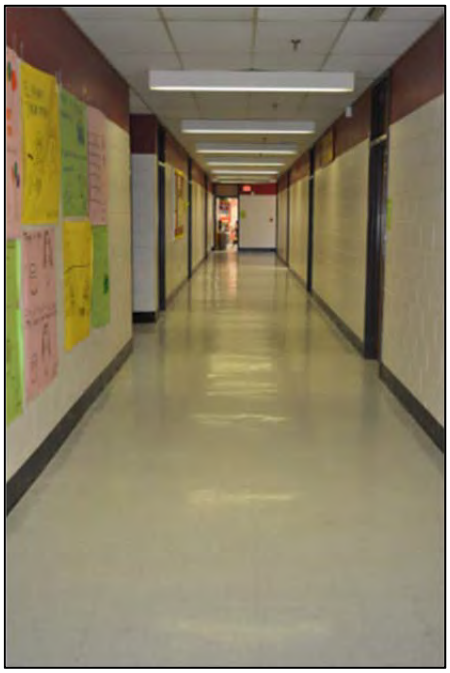

Figure 20. Laura's Photograph of a Hallway Lined with Opened and Closed Doors

> I don't know if you can tell that, but like my door is open and one other door is open… The reason I took that one is (and it could just be the culture here at our school) is that we don't work very well together… As the department, I think we could do a better job working… There's [*sic*] a lot of *individuals* in our department, and so I took this picture because there's [*sic*] lots of doors closed. So, and it's, you end up going to the

> same open doors all the time. And so I think there could be a lot learned from other people if they were willing to share.

Laura went on to explain that when she took the hallway photograph, she was thinking about open doors and closed doors from a collaborative teacher standpoint. Students learned from those who are available, and they continued to go to teachers with whom they connected. However, Laura believed that teachers who quickly shut their doors and left at 3:30 were less available for collaboration and tended to "not push themselves" (Interview) to improve their practice from year to year. She described these teachers as giving the same multiple-choice assessments each year instead of improving assessments and giving partial credit. She pointed out during the interview that if she worked with those teachers, "We'll all give the same tests. I'll walk out at 3:45 every day. And I'll be done!" Laura then described teachers who worked longer hours as "constantly innovating, developing new things" (Interview), because she believed that they wanted to professionally grow. Laura expressed that her school's faculty was comprised of teachers who both left early or worked late. "It doesn't feel like in our school that we have a happy medium." She posited that those within her department who left early were more willing to receive other teachers' materials than to give back. "It's not a one-to-one kind of relationship."

> The attitude goes with the closed door, too. You know, when we're like in a department meeting, there's people that … put their two cents worth, and it's not necessarily productive, a productive two cents, you know what I mean? And then off they go to be individuals again… [T]he big picture here is just, there's really not a lot of community… I mean, it has to do with personalities… It's hard to force somebody into a situation that just doesn't want to be part of that team. (Interview)

Laura associated the time teachers left the building with their willingness to professionally grow and collaborate. She suggested teachers who metaphorically "shut

their door" (Interview) to collaboration desired to work in isolation. Could the teachers who work independently grow professionally? Laura interpreted the closed door mentality as "indication of 'what I'm doing's fine.'… I would interpret that as 'what I'm doing is working and I'm gonna continue to just go my way.'" In the Professional Learning Journal, several of Laura's entries indicated that she desired to work with her peers and yet remained frustrated with those unwilling to collaborate. She wrote in her Professional Learning Journal that "If educators want to learn and improve, it starts with them recognizing the purpose and then being committed to the goal." Unfortunately, she also wrote that her mathematics department was still divided between those who "see the need and purpose for change in the way we teach math and those who are OK with the status quo."

From her various and detailed distinctions between teachers who went home early compared to those who worked late, Laura expressed that working late illustrated a dedication to professional growth and collaboration. In an effort to determine how her parental duties and coaching responsibilities affected the time she left in the afternoon, I asked her whether she felt her door was always open. "My hours are longer than others, but are also sometimes at home… It has a lot to do with the fact that I have kids, whereas some of the other teachers are here, they don't have kids anymore" (Interview). She admitted that she would rather work late and not bring any work home, but she chose not to do that. She felt that her colleagues' doors were shut early for "different reasons" (Interview), yet she did not elaborate as to what those reasons were.

Laura valued the use of technology as long as it helped her students understand mathematics. During a follow-up interview, she said felt like her students had "no

number sense," and that technology played a role her students' mathematical knowledge. "I used our National Debt in an example recently. They don't know the difference between 16 trillion and 16 million." She asserted that because students could just plug numbers into the calculator, they do not truly understand what the numbers represent within the contexts of a problem. Therefore, she felt that technology integration was acceptable only if it was helping her students think, but otherwise, "it's an injustice to the kids" (Follow-Up Interview).

Based on her experience teaching gifted courses, Laura asserted that students needed more opportunities to "explore multiple representations" and "make connections," whereas teachers should "develop material requiring students to synthesis [*sic*]" (Professional Learning Journal Entry). During her interview, she asserted that she used standards-based assessment with her calculus students because they were allowed to retest until they've shown mastery, and then in her Professional Learning Journal, she wrote that she gave open-ended problems to her students on a regular basis. She reflected, "While I'd like to say that many are better risk-takers based on the new curriculum, many still have not bought in to communicating the process without fear of being incorrect" (Professional Learning Journal Entry).

Although challenging, she admitted that developing material for students to synthesize made her a "better teacher overall" (Professional Learning Journal Entry). In order to support teachers, Laura suggested that professional developers group teachers during workshops based on their Mathematical Knowledge for Teaching (MKT). On the discussion board, she shared, "I've been in workshops often with a very diverse group of

teachers based on Mathematical Knowledge for Teaching (MKT). I think much could be learned by all if put in balanced groups by MKT. This rarely happens."

Laura also considered the impact of the educational community's expectations for success, and how those expectations influenced her students' motivation to learn. She indicated that her students had "high expectations for high achievement but not always willingness to work toward that achievement" (Interview). She asserted that her students felt entitled to receive high academic scores, but did not want to work for it. She felt that her students "get what they want when they want it a lot" (Interview) and that her students do not realize that they are accountable for their own learning or their actions. During a follow-up interview, Laura explained that she continued to be frustrated by her students "not wanting to think" and that they just wanted her to tell them how to find the correct answers. She explained that recently, she responded to one of the students request for the mathematical answer, not process, with a metaphor.

> I'm training you to be either a garbage truck driver or a garbage truck engineer. Anyone can walk over to the driveway, pick up the garbage, dump it in the truck and keep moving along. You have to think in order to design the garbage truck.

Laura then emphasized with her students that being a creative thinker was of the utmost importance with problem solving. After she posed the metaphor to her student, she walked over to two garbage cans and emptied one garbage can into the other garbage can. She told her students that as long as they looked to her for the answers and weren't trying to think for themselves, they were just "dumping." To Laura, this process was "meaningless" (Follow-Up Interview). She attributed this complacency to lack of support of teachers from students' parents. She asserted that parents "back the kid… making excuses" (Interview) when their child fails to complete assignments. Laura also indicated

that the parents' stance toward the child's learning also hindered her from providing constructive feedback during conferences in which she, the parents, and the students were present.

> It's difficult when you say, "This child has not done their homework, does maybe 20% of their homework," and the parents more so think it must be the teacher. So I think that, unfortunately, unfortunately I think there's a lot of that in this area… I think at our school we went through a time where there was a shift in perceived power—where the parents had a lot more influence. You know, the demands… "My kid will be in this class"…the administration somewhat caved. (Interview)

She believed that once this attitude in the community was established, it was difficult to change; however, she stated that the new administrator was making an effort to shift the power back to the teachers. "For a while there you were guilty before proven innocent kind of thing" (Interview). But, she felt that her administrators were starting to become more supportive of teachers. Laura also pointed out during the interview that if parents initially contacted the administrators to complain, the administration would "back you first." However, she expressed during the interview that the parents "talk to each other" and that teachers could unfairly "get a reputation" based on false information.

Professional Goals

Unlike several of the other participants, Laura has had the luxury of teaching the same course repeatedly over the past few years. Therefore, one of her goals is to "take what I teach and go deeper, refine, and do something to figure out how to make it better" (Interview). She believed that she spent more time than her peers preparing and improving her course, but pointed out that she would not enjoy teaching a different class that gave common assessments each year. In one discussion with Ed, Site 2's department chair, she commented that she could join one of the other subject area teams that seem to

leave early each day. She then noted that "My department head said, 'You would not be happy with that. You know, because you would not enjoy that.' And, he knows me, and yeah, that's probably true" (Interview).

She also wanted to earn additional endorsements to teach other Advanced Placement courses. She expressed interest in continuing to teach AP Calculus AB and hoped to one day teach AP Calculus BC. "I'm gonna do the BC class cause maybe Ed will retire. We'll see" (Interview). She was also interested in possibly earning the AP Physics certification, because she recognized that much of the AP Calculus content paralleled the content in AP Physics. Although Laura believed that teachers should be life-long learners in order to professionally evolve, she indicated that her teaching assignment of calculus had not changed for the past eight years. Even though she playfully knocked around the idea of teaching lower-level classes so that she could leave by 3:30 each day, she also expressed that teaching a lower-level mathematics class within a larger teaching team would be easier. To Laura, the act of learning and the motivation to learn are inherently intertwined. She indicated that she was not perfect, and that she wanted to professionally improve. She attributed her stance on learning to one of her college professors who she believed impacted her philosophy of learning.

> I had a professor in college that said that if he didn't learn ten new things a day that he felt like the day was not valuable. And this was old man. He was like, seventy-five… It kind of stuck with me. I thought, what you know what, I kind of agree with, I don't necessarily agree about the *ten* new things a day, but I do think… there should be an emphasis—I mean, if I'm asking my students to learn, then how can I not hold myself accountable for learning? (Interview)

She asserted that she was obligated to model learning to her students.

> I've noticed a decline in students' desire to "learn" and not just "do." This observation is also true for many teachers. It is imperative for teacher to

> engage and model learning if we expect the same from our students. (Professional Learning Journal Entry)
>
> As teachers we all hope that our students find the value in becoming lifelong "learners" more so than "doers." This desire should be the same for educators. It is imperative that we engage and model learning if we hope for the same from our students. (Blog Entry)

She expressed an interest in learning about teaching strategies to engage and motivate her students. She stipulated that she wanted to learn more content only if she were teaching a new course. "If I was in the system where we were teaching similar courses over and over, content wouldn't be important" (Interview). In terms of technology, she took the photograph of several calculators to illustrate that teachers should learn technology in order to be able to use "every tool in their toolbox" (Interview). Laura aimed to model learning for her students and hoped to acquire a skill set that motivated her students to be problem solvers. She maintained that her biggest struggle was motivating her students to buy into learning. "I think unfortunately as students, the joy of learning just doesn't really exist" (Interview).

Among the learning goals that Laura mentioned, she specifically mentioned that she desired to take an AP Calculus training in order to earn Professional Learning Units (PLUs). Although she somewhat set this goal, she also sees earning PLUs as a requirement of her state. Despite this requirement, she wanted to use the opportunity to pursue AP Calculus BC credit, in the hopes of one day teaching that class.

Laura suggested that teachers should work together to develop common professional learning goals. In a response to one of the articles in the Professional Learning Journal, Laura wrote, "The process of identifying a common goal and working together to utilizing each individual's expertise to develop a solution is appealing to me.

The willingness of all participants to change beliefs, practices, etc. is a must but not often effective." She believed that teachers' commitment to achieving goals change, making the achievement of goals more difficult. She worked on horizontal teams to develop a common plan, unit assessments, and agreed implementations of their plans, "only to later find out that a particular teacher went out on their own and didn't follow the plan. This was saying that *our* common goal was not *their* goal" (Professional Learning Journal Entry). Laura pointed out that within school cultures, individual teachers may have different goals for their students, and that teachers should collaborate together to clarify their expectations for student achievement.

> When the school culture allows, certain teachers remain autonomous regardless of student success or failure. What determines success or failure of students and who actually holds those teachers accountable is unclear. My definition of student success may be completely different than another team member, an individual student and their parent, and even the administration. Teachers need clearly defined expectations and know that they are accountable for their "product"—whether this is student success, teacher collaboration, etc. (Blog Entry)

Laura asserted that professional learning began when teachers recognized "the purpose and then being committed to the goal" (Blog Entry). Therefore, commitment was a vital component to initiating the learning process.

Motivation to Learn

Even though Laura did not have to teach for the income it brings, there were times when Laura put in "more hours in the day" than her husband did with his job. Although her husband is supportive, Laura recognized that he was the "ultimate bread-winner," and that she was obligated to pick up "more of the load at home. And, there are times that that doesn't happen" (Interview). Laura expressed that she had to become more "selfish" (Interview) with her time in order to take care of her family.

Laura had the financial means to retire from teaching, and she suggested that she was obligated as a wife and mother to take on more responsibilities at home. So, why did she continue to teach? Although her family needed her, she discussed the underlying intrinsic rewards of teaching. For example, after her senior students took the AP Calculus exams, she stated that her students thanked her for successfully preparing them the culminating assessment.

> All the kids after the AP exam they came in and were just like, "You really did a good job preparing us." You know, and I'm like, "Well, you guys did a good job preparing." You know, I just facilitated it. Um. So that's the rewarding part is that there are moments that make you say, "Okay. I really like this."… They're thankful only if you've prepared them, so um. You know, in getting those e-mails every once in a while from different students that say, "Thank you for being so hard, but it really paid off." So, those are nice. You keep those few to make you go, "Oh, I really like teaching." So. I do. I wouldn't go back to engineering. (Interview)

Professionally, Laura believed that teachers should be motivated to learn. Laura related her photograph of the poster that read "You are Responsible for You" to professional learning, asserting that "If you want to expand and become a better teacher… People aren't going to chase after you to professionally learn… It comes down to you choosing to… and taking the time and initiative for development."

Figure 21. Laura's Photograph of the "You are Responsible for You" Poster

Laura described that her motivation to teach waxed and waned throughout the school year. During the interview, I asked her whether she enjoyed teaching at Site 2, and she replied, "You're asking me at the wrong time. I'm tired." She responded that the best

time to ask her was during the "honeymoon stage" at the beginning of the fall semester. She was motivated to adapt and improve upon what she was currently teaching, and yet she also mentioned that she wanted to keep teaching the same content. She proceeded to look around her contexts for motivational posters, not just for students, but for herself. Among the several photographs of motivational posters, Laura attributed the quote in the mathematics department as her motivation to keep learning.

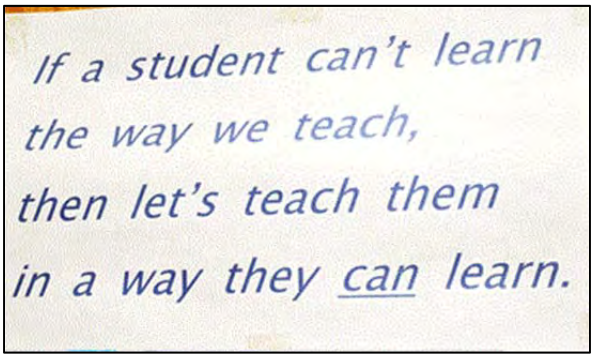

Figure 22. Laura's Photograph of a Departmental Sign

> We have to be constantly changing. We can't be fixed… Students just learned differently compared to the way that we learn. So we have to be evolving and even though we are not, we don't learn that same way. We have to evolve. So I think that was, um, so I took that picture just because it's like the inspiration of why we… have to constantly be learning. (Interview)

Laura explained that her motivation to teach and professionally grow originated with a desire to help her students learn mathematics. She expressed that her students made her feel valued, and she felt obligated to professionally grow in order to be able to continually meet their needs. She believed that teachers should be life-long learners in order to be constantly improving. She recalled that in order to renew her engineering license every two years, she was required to attend classes. In the same regard, she believed that teachers should be expected to constantly learn. "I think there's always something new you can learn. I don't think you ever stop learning" (Interview). She

noted that even though she was teaching calculus again, she frequently looked for ways to improve the class. She believed that requiring teachers to pursue professional learning emphasized the importance of "always being willing to learn" (Interview).

Methods for Learning

Laura indicated during the interview that she was open to learning through online resources, textbooks, collaboration, and observing others. Specifically, she needed to take several classes because she needed to get her teaching certificate renewed. She signed up for classes online, and believed the process of signing up for courses online was "self-initiated" (Interview). As a learner, she recognized that she tended to "compartmentalize" (Interview) her time, and therefore felt that embedded professional learning hindered her immersion into the learning process. Therefore, she favored taking summer classes as they allow teachers to give "100% from that person in that moment" (Interview). Because teachers get busy during the school year, she did not know if they could completely devote themselves to the learning process unless they were committed to and immersed in the class.

She asserted that observing her peers was a powerful form of professional learning. So powerful, in fact, that she stated that teachers should be required "to audit or observe other teachers that are doing things that are really good. I mean, probably also observing the other—things that are *not* good." In one instance, she recalled observing a colleague at Site 2 outside of her department. She observed "one teacher who everybody rants and raves about" (Interview). During the observation, she noticed that the teacher was "high energy 100% of the time," and she explained during the interview that she attributed the educator's energy to not having children. In this instance, Laura wanted to

observe characteristics of an excellent teacher, so she narrowed her focus to observe teachers who possessed an engaging instructional style. As a result, Laura posited that the teacher had more time to devote to the profession because she did not have children.

Methods for Learning to Teach a New Class

During the interview, Laura described the process of learning a new topic as "overwhelming." In particular, she photographed a bookcase to demonstrate that synthesizing information from various resources can be difficult. The bookcase symbolized that the process of looking for resources is not guided. She explained, "It's like walking into a library" (Interview). She also recalled that when she learned to teach something new, she sought textbooks on the bookcase and looked for texts by "pulling out [and] looking" at them to see what was available. In addition to using multiple resources, Laura also sought out peers who had taught the course before in order to obtain outlines and assignments. Then she identified areas in which she needed additional support. "I probably identify what I feel comfortable with and the things that I felt the most uncomfortable with. Probably tackle the uncomfortable ones first" (Interview). She would then rely on her peers within her department or within the school district to help her. "I know quite a few teachers in the county… So you can always reach out" (Interview).

Laura recalled that her own experiences as a student also helped her to teach herself mathematics. For example, she explained that when she was first learning how to teach AP Calculus, she had not worked the curriculum since she enrolled in a calculus class in college. She recalled that she was "sort of teaching myself and teaching others. So, it was almost like a learning community… I become more savvy about the ways of

helping students, you know, seeing things that at the time, I didn't put together" (Interview). Laura pointed out that she viewed her students as a resource, and that her classes were like a learning community. "We were all in it together" (Interview). Therefore, Laura viewed textbooks, her peers, and her students as resources and valued reflecting about her own learning experiences to help reteach herself content.

Positive and Negative Learning Experiences

One notable professional learning experience that Laura described during the interview took place during an in-service provided by her school district. The session provided "a lot of neat things, really good ideas that were cross-curriculum." She was motivated to try at least one of the strategies. "The whole tri-fold notes stuff. Do I still use them today? No. Um. Have I used them? I have used them before… but I don't use them on a regular basis."

When Laura evaluated the effectiveness of professional learning, she just kept trying to use the products from the session, such as graphic organizers, to see if it "worked or didn't work" (Interview). She continued to use them after she initially worked with the strategy, but she admitted that she does not use them now. Conversely, she described other sessions that her school district provided, and stated that the session facilitators motivated her use strategies that were difficult to implement once she got back to her school. For instance, Laura described a teacher from one of the other high school who led a workshop discussion on standards-based assessments. She found the workshop to be inspiring, but struggled to implement the strategies.

> It was inspiring. I think what's difficult about a lot of these professional, you know, go learn and, is just, you get *all* motivated when you're there. And then you get back in and it's very quickly that things can get in your way or become hindrances or, you know, hurdles. And you just

> *abandon*—... And, and that happens a lot with professional learning. Kind of this momentary, "Oh yeah! Yeah! Yeah!" And then you get back in the classroom and, you kind of, it gets spoiled real quickly. It's almost like reality again. (Interview)

She found that professional learning sessions provided by her school district to be "good, and frustrating" (Interview) in that although the district provided support for using some technology, Laura maintained that she did not have access to all the technology at Site 2. She wanted to use the technology, and she expressed that she was inspired to try something new; however, when she returned to her classroom, her context, and her habits, she just left those ideas behind. The realities and stresses of her life as a teacher distracted her from successfully implementing the ideas—even if she was motivated to try them. Laura's perspective adds a different element to the evaluation of professional learning. She was open-minded and inspired, yet the busy contexts of her school distracted her. Laura slipped back into familiar instructional habits within the comfort of her classroom setting.

Laura described one of her least favorite learning experiences through discussion board posting. She suggested that meaningful professional learning experiences were "initiated by the individual teacher in an informal and organic setting." During the interview, she described one particular school district professional learning workshop as "just horrible." Her school district had bought a software program called Maple for the all the schools. Then the session facilitators showed the teachers in the session how to use the software program. Laura described the experience.

> "Oh! Here's what it does and here's what it does." And for statistics teachers or maybe BC teachers who can actually get through the curriculum, Maple was great. It was not for everybody, but yet they spent all this money on buying Maple for countywide, and it was just, we had to figure how to justify why they bought it. It was horrible. (Interview)

In this example, Laura believed the school district's initiative of encouraging teachers to use the software program as a waste of educational funds because it was not a tool that every mathematics teacher needed for their course. Overall, she expressed that opportunities provided by her county "pales in comparison" (Blog Entry) to those that she initiated and attended on her own accord.

Belief Systems

When Laura thought through the questions during the interview, she would often consider the questions from multiple perspectives. The WWK position that most accurately fits Laura is procedural knowing, as she consistently tried to connect with or separate from different perspectives as she answered questions. For example, Laura tried to explain that in only some cases would she be interested in professional learning that focused on content matter.

> It depends. I mean, if I was going to teach a new course, then content would have been important to me. If… there were new courses being rolled out, content would be important to me. Like what's happening right now, how we constantly change… I think content would be important to me; however, if I was in the system where we were teaching similar courses over and over… content wouldn't be important. So… it depends.

Laura made sense of things by comparing her situation to others. During the interview, she spoke about the benefits of teachers observing each other, and how other teachers may perceive the process. She considered several different perspectives before making her opinion clear.

> Student teaching can be an overwhelming time for most, and while feedback and coaching occurs on a daily basis, the effectiveness is surface level. Our classroom experiences are way too immature at this stage for any feedback/coaching to impact us in long term... Now as a veteran teacher, I still wouldn't be opposed to being observed/coached by someone qualified in mathematics, but I know of several teachers at my

> school that would be intimidated, offended, and/or strongly opposed. (Blog Entry)

When I asked her whether she viewed parental involvement at Site 2 as a drawback to teaching, she indicated that that was a difficult question to answer. Then she comparatively thought about what it may be like teaching at other "at risk" schools (Interview). She noted that teachers could teach "in an inner-city school… where parents don't care at all… Completely different set of circumstances, so whether you would enjoy that one more versus the other, I don't know" (Interview).

Laura also demonstrated some characteristics that are consistent with constructivist knowing. Belenky et al. (1994) point out that "constructivists understand that all questions vary depending on the contexts in which they are asked and on the frame of reference of the person doing the asking" (p. 138). As Laura explained her position, she would use the caveat of "it depends" (Interview), and then she would consider multiple perspectives or cases to answer the question. For example, when I asked her whether she considered content-specific classes as professional learning, she responded with, "It depends." Then, she explained how her answer to the question would be different within various contexts.

> I think it would depend on the college class… (7 second pause) I, I'm trying to think of some examples. I would tend to say it would depend, but literally if I were gonna start teaching Statistics, which I took two years or two semesters of College Statistics, and I absolutely hated it… If I had to… go back and was planning on teaching them, then yeah I would consider that professional learning. But if I just took it for enrichment, you know… just to take it… It just depends on the class I would tend to say. (Interview)

When I asked her whether she would be interested in professional learning that focused on content, she replied again that "It depends." As Belenky et al. (1986) point

out, “For constructivist women, simple questions are as rare as simple answers” (p. 139). Laura considered several different perspectives, and then she asserted that the content would be important to her if she was “going to teach a new course… However, if I was in the system where we were teaching similar courses over and over… content wouldn’t be important… It depends” (Interview). Belenky et al. (1986) point out that connected knowers are interested “in the facts of other people’s lives, but gradually shift the focus to other people’s ways of thinking. As in all procedural knowing, it is the form rather than the content of knowing that is central” (p. 115). Constructivists critique arguments, confidently listen, show empathy, and balance their concern for finding deep understanding of what they are trying to learn through both subjective and objective learning (Belenky et al., 1986). Although Laura considered multiple perspectives within her responses during the interview, she situated her perspective through procedural knowing characteristics.

Laura’s emphasis on “form rather than content of knowing” (Belenky, et al., 1994, p. 115) is one primary characteristic of procedural knowers. Belenky et al. (1994) indicate that procedural knowers who learn through connected knowing “begin with an interest in the facts of other people’s lives, but they gradually shift the focus to other people’s ways of thinking… Connected knowers learn through empathy” (Belenky et al., 1994, p. 115).

Much like connected knowers who “got out from behind their own eyes and use a different lens” (Belenky et al., 1994, p. 115), Laura voiced her perspective and position while giving consideration to positions of her peers. She demonstrated this again when I asked her whether she was interested in the professional learning offered during the

summer. Laura responded, “It probably could be, for some people, it could be more viable. For me personally, probably” (Interview). Laura frequently used comparisons of positions when giving her explanations. For instance, when Laura described her perception of “8:30 to 3:30 teachers” (Interview), she suggested that they did not push or extend themselves professionally.

> They are typically… maybe the assessments they give them, year after year, they are the same assessment… They’re multiple-choice, they’re not grading for… partial credit… They’re almost just very routine… That would be my impression of the teachers… We don’t really have, I guess that maybe my opinion, it doesn’t feel like in our school that we have a happy medium. (Interview)

> While I’m an active participant of collaboration with one horizontal team, the other horizontal team I’m associated with is not a team at all and is more of a case of “contrieved congeniality” [*sic*]… Successful collaboration is really dependent on the personalities, experiences, willingness, attitudes, and egos of the team members. When it comes to working with other team members, some teachers are not “professional” at all. (Blog Entry)

> In our school we have basically two groups of math teachers, those that see the need and purpose for change in the way we teach math and those that are OK with the status quo. The first group regularly engages in meaningful P.L. while the others just punch the time clock. (Professional Learning Journal Entry)

Laura recognized that different people have different perspectives on student achievement and acknowledged that her “definition of student success may be completely different than another team member, an individual student and their parent, and even the administration” (Blog Entry). Therefore, she suggested that teachers who work together have or develop clear expectations about their goals for collaboration. Laura expressed her thoughts and explained her reasoning through comparisons. She also demonstrated that she learned through comparisons as well. For example, during the interview she noted that she learned about teaching practices by comparing her teaching style to others.

Laura described one year when members of her faculty were instructed to observe teachers outside of their department.

> And so, of course when I observed, you know, one teacher who everybody rants and raves about… I sat there and watched the whole time and thought, "Wow! How does she keep the high-energy? … Twenty-four/seven kind of thing." Well, no kids. Only has the dog, you know. I'm kind of thinking that's sort of situational. (Interview)

She used this example to transition into her description of how her role as a mother and coach forced her to make choices that colleagues, like the one she observed, did not have to make. All of the examples illustrate how Laura begins with interests "in the facts of other people's lives" to help her discover the rationale or the motives behind other people's behavior (Belenky et al., 1986, p. 115). Therefore, as a procedural knower, she gained knowledge through connected knowing as she perceived personalities or contexts that influenced others' perceptions or opinions. She expressed frustration about her departmental colleagues who she believed as uncooperative. She recognized that she learned by working with and connecting with others. Laura explained, "I think there could be a lot learned from other people if they were willing to share" (Interview). Belenky et al. (1986) point out that constructive knowers weave together "the strands of rational and emotive thought and of integrating objective and subjective knowing" (p. 134). What aspects of constructive knowing did Laura not demonstrate? She did not discuss constructing knowledge with others. Although she recognized her calculus students as part of her learning community when she learned to teach calculus for the first time, she did not detail how she constructed knowledge with them during the process. Laura observed her colleagues, but she did not describe how she collaborated with or constructed knowledge with them.

Laura's educational ideology most closely resembled the old humanist perspective; however, there were also elements of the technological pragmatist perspective as well. She did not state whether she thought her students' mathematical abilities were inherently limited, but she was concerned with their level of interest or motivation to learn mathematics. For her, the parents within Site 2's community contributed to her students' sense of mathematical apathy. She stated that "I think kids *from this area* [emphasis added] tend to get what they want when they want it a lot… The kids not being accountable for their actions, and the parents not really backing the teacher" (Interview). Laura pointed out that there was "a direct correlation to their not performing" (Interview) and the level to which her students were not held accountable for their actions by their parents. Laura believed that the parents' political power within Site 2 also contributed to how much the teachers were supported by the administrators.

> I think at our school we went through a time where there was a shift in believed power, um, where the parents had a lot more influence… There for a while there you were guilty before proven innocent kind of thing. I would like to believe that it's shifting back. There's been a couple things that I believe it is. But, you know, parents are parents. They talk to each other. (Interview)

Laura described her school as "demanding, high-expectations, [and] consuming" on the free-response item from the initial survey. She recognized how power struggles between teachers, parents, and students influenced her students' motivation to learn.

Laura indicated that one of the biggest challenges in teaching mathematics was motivating her students to think for themselves. She became frustrated when students only looked to her for the correct answers. As previously discussed, Laura's garbage truck metaphor that she explains to her students indicated that she wanted her students to understand mathematics and apply their knowledge. She used the visual aid of the

garbage can to illustrate this metaphor, emphasizing that she wanted them to be able to design the garbage truck, not just be able to operate the truck. She wanted them to think for themselves as she saw critical thinking as a skill they would need in the real world. Much like the technological pragmatist perspective of teaching and learning mathematics, Laura wanted her students to understand, make connections, and be able to apply their knowledge to real-world examples. During the interview, Laura indicated that because she was an engineer prior to becoming a teacher, she aimed to help her students make real-world connections to mathematics.

> I definitely try to incorporate all the time, you know, extensions of how they're going to use this math, and why they're learning it and whatever. So, I think there are probably the, I think being able to make those connections with the kids is important and so, because of my background, I am able to do that. (Interview)

She also strove to explain mathematics and motivate her students to learn. She acknowledged that power struggles between teachers, students, and parents could hinder her instructional practices if she and her students were not positively supported by Site 2's administrators and her students' parents. Therefore, Laura's perspective of teaching and learning mathematics was blended between the old humanist and the technological pragmatist educational ideologies.

CHAPTER 10: ED'S PROFESSIONAL LEARNING PROFILE

Background

Ed has been teaching mathematics at Site 2 for over 30 years. During that time, he has been awarded Teacher of the Year several times, and he served as the mathematics department chair during the time of the study. Ed had earned a Bachelor of Science degree with a double major in Mathematics and Drama. He had also earned a Master's degree in Education in Secondary Mathematics as well as a gifted certification. During the time of the study, Ed taught AP Calculus BC and the honors 10th grade mathematics course. Throughout his years of teaching experience, Ed had taught every mathematics course except AP Statistics. In addition to coaching Math Team , he also presented on various topics related to mathematics and mathematics education at several state and national conferences. Ed was married to Ellen, and the couple did not have any children.

Photographs

Ed took 16 photographs. He took five photographs of mathematical posters within his room that displayed phrases such as "Math Counts," "Math is Infinite," "We Use Math Every Day," and "Math Rocks." Another photograph contained a poster of his state's standards that he taught in his honors 10th grade mathematics course. Three of his photographs were of the same posters that Laura photographed: one poster asking "When are we ever gonna have to use this?;" the quote that hung in the mathematics workroom that read, "If a student can't learn the way we teach, then let's teach them in a way they

can learn;" and finally, the same large poster that hung in the mathematics wing of the school that read, "You are Responsible for You."

Ed explained that he also included photographs of tools for learning. These photographs contained images of the AP Calculus textbook resources for teachers, a laptop sitting atop a desk with two graphing calculators connected by a cord, and a shelving system containing two columns of eight slide-out bucket shelves with various labels such as "Mirrors and Puzzles," "Geometry Tools," "Origami Paper," and "Measuring Devices." Ed's other photographs included a picture of fluffy clouds in the blue sky, Math Team trophies, a Teacher of the Year plaque than hung in the school's hallway, posters of Albert Einstein, and his bulletin board that displayed pictures and backgrounds of various mathematicians. Because Ed provided so many photographs, I asked him to select and rank five photographs to discuss. Ed's number one photograph was the most personal photograph of them all—a mathematical cartoon made for him by a calculus student from years ago. He said he chose it (Figure 23) as the first picture to discuss because it was personal and because he believed professional learning should be "light-hearted and fun" (Interview).

The other photographs that he chose to discuss included his bulletin board of mathematicians, Albert Einstein posters, a poster that said "We use mathematics every day," and the poster that read, "When are we ever gonna have to use this?" He also tied two photos: the buckets of manipulatives and the photo of the laptop with the graphing calculators.

Prior to the interview, I noticed that Ed's pictures uniquely captured notable mathematicians and several forms of recognition (the Teacher of the Year plaque as well

as the trophies). In terms of resources, he took pictures of technology and manipulatives. During the interview, he revealed that his perspective as a Drama major guided his ideas for the focus of his photographs because appreciated symbolism.

Figure 23. Ed's Photograph of Student Mathematical Artwork

Therefore, he intentionally took pictures that could have multiple interpretations. Throughout the interview, Ed challenged me to guess the meanings behind several photographs. Only when I asked Ed directly did he reveal *his* meaning behind the photographs and how he felt the subject matter related to professional learning. Overall, his photographs revealed his perspective on learning and how professional learning for teachers should take place.

Perspective of Learning and Teaching Mathematics

Ed believed that learning occurred through the problem-solving process. Initially, he described problem solving through own his process of learning. He explained that when he was "stymied by something" (Interview), he looked for resources through the Internet. He avoided looking for someone to just tell him the answer.

> I'm the kind of person who, if I can't get something to work on a calculator, and I get to the point where I come ask you, I don't want you to take my calculator, press the buttons, and say, this is what you do. You

> know. I want you to tell me, and I still need to figure it out. So almost to the point of I'd really like you to say, "Well, have you looked under the math key?" But I want, if necessary, some scaffolding and some guidance to get there. But if I don't do it myself, I haven't done it. (Interview)

He also asserted that student learning takes place through problem solving as well. He explained, for example, that if his students were struggling to figure out how to perform an operation with their graphing calculator, he tried to "refrain from ever touching the buttons on their calculator" (Interview). He gave them many different "ways of where to go," but avoided just telling them which calculator buttons to press. He wanted them to think throughout the process in order to "internalize what's going on" (Interview) and wanted his students to experience learning through all of their senses.

> I want them to experience *their* voice. I want them to hear me saying things. I want them to visually be looking at the keyboard, I want them to be touching it, you know, doing all your sensing modality… I think you have to accomplish all those for the learning to really take place and be successful and internalized, the way it needs to be. (Interview)

Although he admitted that it may be easier for educators to tell the students exactly what to do, he suggested that giving too much help would ultimately undermine the learning process. He wanted his students to experience learning through the process that he preferred to learn—problem solving. "I don't want someone to just come in and solve the problem for me… -You know, unless I'm just extremely tired."

Because of this problem-solving and discovery philosophy of education, Ed resented the idea of having to put Essential Questions (EQ) on the board. Posting an Essential Question on the board is a strategy of writing the learning goal of the day on the board in question form so that the students have one essential question that they should be able to answer after the lesson is over. It sums up the lesson and gives the activity a purpose. Ed believed that posting EQs or standards undermined the purpose of discovery.

> You don't have them discover things by telling them, when they walk in the door, what it is you're going to discover… There's no discovery going on. There's no thought process, problem solving, in why would we want to do it, and why is it going to be done that way, it's like, uh, here it is. (Interview)

Ed felt that many mathematics teachers "unless they made a real conscientious effort probably are teaching the way they were taught in school. Ed believed that professional learning should be differentiated, and the goal should be applicable to teaching mathematics" (Interview). He believed teachers resist stepping out of their comfort zone to learn something new.

> Think about the kids you probably have in your class who are going… to solve a system of equations this way. "Can't I just do substitution, because I've always done substitution?" "Well, yes, and it will always work, and sometimes it takes two steps, and sometimes it takes twenty steps. But it always works. Let's look at doing it a different way." It can be a little uncomfortable in doing this; you can weigh the advantages and disadvantages. (Interview)

Ed claimed during the interview that "learning is learning," and that teachers needed to be "forced to stretch" sometimes to get out of their comfort zones and try new things in the classroom. Regardless of the teachers' learning goals or learning processes, Ed suggested that good mathematics teachers had to demonstrate "willingness to change" (Interview).

Ed noted that one of the most difficult aspects of teaching was engaging students who have rapidly decreasing attention spans. He felt that his students possessed a great need for "immediate gratification." During the interview Ed compared his current students to those he taught 10 year ago, and asserted that his current students were less likely to naturally explore their calculators or write programs for their calculators than his

previous students. He stated that if his students wanted to do something and they could not "do it in fifteen seconds…it's not worth it."

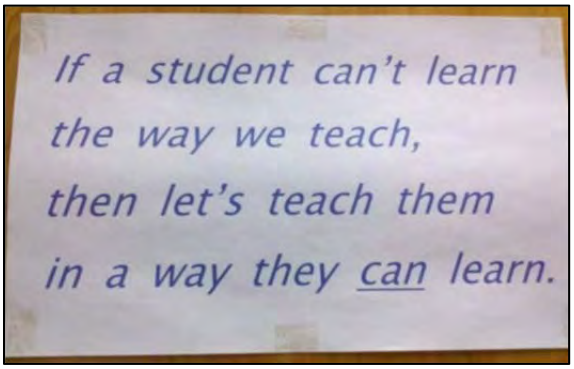

Figure 24. Ed's Photograph of a Departmental Sign

He explained that a decade ago, he would have students who could figure out how to program their calculator to do all the work for them. Ed also stated that his students' abilities to program their calculators posed several assessment problems. For example, Ed pointed out that students discovered the conics application on their graphing calculator. "You'd have five or six in every class. They would find it, and they would start spreading the word" (Interview). He claimed that his current students did not know or even try to seek out the conics application. The fact that his students were less willing to discover the calculator's capabilities without being prompted bothered Ed, and he thought it pointed to his students' a lack of attentiveness. Ed noted that after the conics test, he dropped the bombshell that the conics application was there on their calculator the entire time. He told them, "For those of you who used the conics app, you realize that question three and question five, you can do it two steps" (Interview). Perplexed, his students immediately felt robbed and wanted Ed to walk them step-by-step through the application. When they asked him why he had not revealed the user-friendly program, he retorted, "It's all on the machine you have on your desk. You have access twenty-four

hours a day. I don't have to tell you" (Interview). In other words, he expected them to figure it out for themselves.

To Ed, expert teachers modeled a love of learning, adapted to problematic situations if something went wrong with their lessons, and humbly discussed educational problems with their colleagues freely. Although Ed thought that content knowledge was important, he did not think that expert teachers should know everything.

> I'm not sure they should always have all the answers. But I think they've got to model for students the eagerness to learn, the willingness to learn, the willingness to problem solve, the flexibility that's involved with doing that. Um, they've got to roll with the punches… It… comes into personality… I don't know of many very good math teachers who are uptight, who have to be in control. Not even talking classroom discipline per se, but have to be in control in the sense that they have to know everything, everything has to go their way with it. The people I know who are good math teachers, um, are very flexible. (Interview)

The excellent teachers Ed had in mind freely talked about how things went wrong in class, and explained how they overcame these problems to create "a great lesson" (Interview). These teachers viewed mistakes or sidetracks as minor setbacks because they could gracefully recover from them. He asserted that expert teachers are "going to turn it into a learning moment regardless." Ed equated these teaching moments to a drama production in which the teachers were the actors. Although actors memorize their lines, "invariably, things go wrong, people forget their lines, the vase falls off of the table" (Interview). He pointed out that the actor stays in character and played out the scene. Likewise, if things in the classroom went wrong, expert teachers were able to adapt to the challenge and improvise, and Ed suggested that these teachers be emulated. One of his photographs displayed his bulletin board of mathematicians and another photograph displayed posters of Albert Einstein hanging on his classroom wall.

Figure 25. Ed's Photograph of a Bulletin Board of Mathematicians

He sarcastically pointed out that he was not familiar with "a poster set of great math teachers throughout history" and assumed that a poster set of great mathematicians was "basically the same thing" (Interview). He explained that mathematics teachers should be mathematicians who love mathematics and problem solving. His photograph of Site 2's "Teacher of the Year" sign illustrated different teachers who were acknowledged as experts in their field. Ed stated that the Teacher of the Year display was initiated approximately 15 years prior to promote character education. In order to recognize "good things" (Interview), the display included valedictorians, salutatorians, Star Teachers and Students, and Teachers of the Year. Administrators and teachers worked together to back-track and found yearbook pictures of every teacher who had been awarded the Teacher of the Year recognition since the opening of the school. Ed attested to the location and meaning of the display, and indicated that it was put in prominent location to illustrate that "these are things we value" (Interview). After the display had been established in collaboration by both teachers and administration, the display was updated only by teachers.

Ed suggested that the photograph of the display related to professional learning because “These are your master teachers. These are the people you should be learning from—emulating” (Interview). As the interview continued, I asked Ed whether he thought he was an expert teacher, and he revealed that he was “getting there.” He pointed out that “There are good days and bad days. There are days when I feel like I’ve done nothing.” However, he noted that he had improved since he had begun teaching so many years ago. Although his picture was among the several Teachers of the Year within the display, and even though Ed felt that these teachers should be viewed as mentor teachers, he did not believe he had reached *expert teache*r status.

In addition, Ed pointed out that adaptation, humility, and communication about professional growth were defining characteristics of expert teachers. As the department chair, he recalled how he observed and worked with teachers of various levels of experience. He described observing some teachers who could not cope or adapt when something went wrong in class. Ed stated during the interview that these teachers had “done all their homework” and worked “every single problem that they assigned for homework.” However, they became completely flustered when a problem they were working out in class went wrong. Ed described the situation in which a teacher made a mathematical mistake while working out a problem during a class lesson. Although the students may see where the teacher went wrong, Ed pointed out that “Your kids are no help,” and they won’t tell teachers where they dropped a negative sign or miscopied the problem. In this moment, some teachers “go into an absolute panic” (Interview) and allow the mistake to “totally destroy their entire class” (Interview). These teachers develop a mental block as they struggle to work the problem out correctly. Ed argued that

it was important to let the students witness teachers struggling with mathematics, and pointed out that expert teachers turned these missteps into teachable, learning moments that they comfortably shared with their colleagues.

Professional Goals

When asked about his professional and educational goals, Ed proclaimed during the interview that the "sky is the limit!" He stated that a ceiling on learning did not exist. When I asked him how his cloud photograph related to professional learning, he smiled and raised his hands to respond, "Because the sky's the limit!" I asked him whether he was referring to professional learning or mathematics, and he retorted, "All of 'em!"

Figure 26. Ed's Photograph of the Sky

When I asked him of his professional long-term and short-term goals, he asserted that even though his 35th year of teaching was still fun, he had not "set goals particularly… I tend to do things, and when I'm satisfied I've done it, and then it's time for me to leave it" (Interview). He described how he played high school basketball, and then stopped playing basketball in college because he wanted to try something new—like drama. He enjoyed his drama classes so much that he decided to major in the field.

Although he was content with his experience playing basketball in high school, he was open and willing to step outside of his comfort zone and to learn about other areas of interest. It was not that he struggled to set goals; instead, he did not want to be confined by the goal-setting process. This process of learning new things was organic and ongoing. "I can't think of any point where I was thinking this is where I wanted to be in ten, twenty years from now" (Interview). Then, he smiled and pointed out, "That scuttles all those questions about goals for you, I know" (Interview). Overall, he believed that educational goals for teachers and students alike should be clearly defined, and he underscored that professional learning should be content-related, light-hearted, contextual, and fun. However, in terms of his own goals, Ed lived in the moment of his own learning—not for survival, but for enjoyment.

Ed pursued various topics of interest out of a desire to learn and to improve his MKT. When I asked him what he wanted to learn, he responded that "it depends" as he evaluated meaningful learning by its significance to his practice, career stage, or his interests. Ed enjoyed learning about topics that he found interesting or transferable into his practice as an educator, such as technology integration, physics, and mathematical content. Often, it depended on what was being offered, who taught the lessons, and what Ed's learning needs were at that time. In terms of learning mathematically related content matter, Ed's interest depended on the topic and its relevance to what he was teaching. Then, he continued to say that his learning could be for his students *or* himself. "It could be either. I don't have to always go learn something for my kids. I can learn things for myself—and vice versa. And it's great if it is an overlap" (Interview). Because his primary learning goal was to keep learning, growing, and evolving his practice, he

focused on topics that helped him to build on and improve his current knowledge or see his practice in a new way.

Ed stated that his lessons were not perfect. There was usually a topic he could reteach or something he could have done better. “Maybe I did a super job and, yes, I reached most of all the kids, but little Johnny out there is tuned out for five minutes. What could I have done different that would have gotten him engaged throughout the entire lesson?” (Interview). Ed sought after ways to improve his performance in the classroom. However, he felt that different perspectives on reaching “your professional best” were subjective to the learner.

> I’m reminded of a department chair that used to be here, and retired twenty years ago, ten years ago, whatever. We had a debate one time about, uh, I guess it was about teacher evaluations. I think we had some sort of self-evaluation or something, kind of thing... And she had marked, or I think she had marked, herself excellent in everything. She was a very good teacher. Excellent. And, uh, several of us in there had not done that… So as teachers kinda evaluate ourselves, we generally did not mark ourselves as, you know, one of the top two or three ever. We marked ourselves the top one percent maybe in a couple of things, we tended, even those of us who thought we were very good teachers to mark ourselves maybe the top five, top ten percent… sort of thing. And she was like, “But you’re a fantastic teacher. You ought to be at the top.” And I said, “Nah, there are always things I can improve on.” (Interview)

Moreover, those colleagues that he viewed as “very good teachers” had different perspectives of their self-evaluations. Some thought they could still improve, whereas others thought they were superior in every category. Ed felt that he frequently had areas of improvement that he could address. As a department chair, he pointed out that individuals’ definitions on success vary. If teachers believe their current practices are successful, they have no reason to change their habits or learn something new. As a department chair, he assumed the task of both encouraging his department to grow and

providing valid justifications for trying something new. He indicated that he posted things in the department lounge to encourage the teachers to think about their instructional practices.

> And that's the tough part because some of them are very resistant, because some of them are of the view that, you know, this is the way I've always done it, this is quote unquote what has always worked, um, and of course, that depends on what their definition of work is. Yes, but this is what has always worked, and so, there's no reason to change. It's going to require effort on my part, why do I need to, this has always worked... So, if you don't mandate that they go to things like that, they won't, they won't ever get started... We know that. But if you go, and you get one or two people who ordinarily do nothing, and suddenly they do something. *That's a success*. (Interview)

Motivation to Learn

Ed was motivated to reflect and learn from his teaching experiences because he wanted to become a better teacher for his students. He desired to professionally grow through giving and receiving feedback from peers as they discussed their practices and teaching experiences. He felt that humility and being a receptive listener was important, and that ultimately, his students would be the ones benefiting from his growth.

> You have to get feedback. You have to be able to share, hopefully in a non-threatening sort of way, and that's kinda tricky. And then as the receiving teacher, you have to listen with the best interest of the students at heart, because this is what they need. And, I need to share this, and I can't feel threatened because, yes, I was an idiot and didn't teach them that, or didn't think about that, and yes, I screwed up, I'm sorry. But I need to use this as an opportunity then to improve what I'm doing with my kids so they're better prepared then, the following year. (Interview)

Ed believed there was an embedded "sense of excellence" within Site 2's culture, and that many teachers already shared their best practices. However, he thought this collaborative spirit posed a problem because teachers from Site 2 shared their practices with educators from other competing schools. "If we have something that we think we're

doing right, that others can use, we want you to have it, to use it, so your kids are going to do well too" (Interview). Ed pointed out that giving away all of their "secrets" as Math Team coaches would ultimately hurt their competitive edge at state competitions; however, collegial collaboration was "the right thing to do" (Interview). Ed suggested that all educators should work together even if their students are competing against one another. This sentiment and his explanation highlighted Ed's motivation for learning.

> We're all in this together… If you look at it from the competitive endpoint… maybe that's a determent, but for a lot of us, education's important, the kids are important, it's what can we do to make the learning experience the best possible for everybody involved. (Interview)

Methods for Learning

Depending on the educational goal, Ed learned through problem solving, scaffolding, and feedback from others. If he encountered a problem, he sought out those who would scaffold the learning process only after he first attempted to solve the problem independently. Ed provided an example of his learning process by describing trying to figure out how to manipulate his graphing calculator. He indicated that he would try to figure it out first and exhaust his options prior to seeking out help from his peers. When he did finally ask for help, he sought hints—not answers. "Don't tell me everything. Just kinda tell me where to get started" (Interview). He still wanted the opportunity to figure things out for himself even after some scaffolding. "Let me go play a little bit more, and okay, then I'll come see you again and ask you more questions." Ed felt that through problem solving, he truly learned, and that if someone just told him the solution process, he or she robbed him of the opportunity to discover the process for himself. "If I don't do it myself, I haven't done it" (Interview).

During the implementation of new lessons, Ed valued and utilized his students' feedback to help him refine his lessons. He indicated that as he used new discovery activities, he listened to his students' questions and feedback, and then reflected. He acknowledged his students' feedback and commented that he would tell the student, "You're right. If I added this little phrase in here, it would probably clarify that question." Before the end of school day, he jotted himself a note and edited the worksheet on his computer. Ed made a concerted effort to "edit it *right now*, before any time goes by" (Interview). Ed felt that the cycle of listening to student feedback and making corrections to his lessons was "always a work in progress" (Interview).

In addition to his students, Ed sought out peers at his school and other schools for a variety of reasons. He collaborated with Ellen, as she taught his students the year before they took his calculus class. For instance, he approached Ellen to let her know that his students could not "do absolute value worth diddly-squat" (Interview). Then, she adjusted her lessons to emphasize that topic a bit more, and Ed noted that the following year, his students were more prepared. He indicated that being able to give and receive feedback with his peers in a "non-threatening way" was critical in the ongoing process of professional learning. Ed also believed that reciprocity of feedback and sharing ideas helped teachers learn from experiences when they find that they have glossed over important topics or that they have taught something wrong.

Ed's love for learning through collaboration motivated him to attend and become more involved in professional conferences and workshops. With Ellen, Ed traveled to several local and national professional conferences during the school year and the summer. When I followed up with Ed, he explained that attending these conferences

exposed him to high-quality teachers who modeled successful strategies. To Ed, attending and presenting at conferences was an important part of his professional learning. Although he had "taught forever" (Interview), there was usually something that he could learn. He stated that "Learning is a two-way street." Conferences afforded him the opportunity to be both the learner and sharer in a place in which he found himself "spreading the knowledge" with other educators. Although he did not always specify particular learning goals for the conferences, he professed to enjoy fostering the growth of newer teachers through sharing ideas and through facilitating sessions. He even learned from sessions that he had previously attended as there was usually something different that he could take away from the experience. He also enjoyed collaborating with newer teachers. "But I can sit with people, and I can help explain, and I can offer suggestions. This is what I did in class… act as a catalyst… to hopefully enhance their learning and what they're getting out of the session" (Interview). He felt obligated, as an experienced teacher, to "lay the ground work" (Interview) for the next generation of teachers. In addition, Ed attended various conferences to learn from his mentors who he respected as experts in their field or teaching area. For example, even though he considered himself to be proficient in using graphing calculators, he would still be interested in attending technology workshops that were facilitated by graphing calculator gurus whom he respected and believed to be expert teachers. He expressed that "no matter what," he would learn something worthwhile from them.

Methods for Learning to Teach a New Class

Ed's process of preparing to teach a new course included finding tangible resources and seeking out a support system with others who were also teaching the

course. During the interview I asked Ed how he would learn to teach Linear Algebra for the first time. He stated that at first he would seek out the school's textbook for the course, as well as several other textbooks. Then, he would "find other people who are teaching it who I can make contact with if I need a community for support throughout the year" (Interview). This learning community would have members both inside and outside of Site 2.

He recalled that Ellen survived her first year of teaching Analysis by collaborating with several of the Math Team coaches from all over the state. They worked together during Math Team competitions and conversed "on the phone probably two or three nights a week" to discuss how they were going to teach various topics. Within this community, Ellen asked her peers for clarification of content matter or shared assessment materials through the school system's county mail. Ed liked the idea of utilizing a learning community because he believed there were advantages in learning from other teachers who taught the same subject and who maintained different perspectives of teaching mathematics. "We got to [collaborate together] because we emphasize different things" (Interview). He indicated that he used a similar learning community when he taught calculus for the first time. He had "calculus folks" (Interview) in the community with whom he felt comfortable asking a variety of questions. "If it's a technology issue or if it's just a different way to approach it… So I would try to do the same thing with Linear Algebra. I would search out, who probably teaches it" (Interview). Ed indicated that he would refer to those he admired and respected in private schools or magnet schools in which Linear Algebra would most likely be offered. "So I have some folks who I know I can very quickly round up and

say, I'm stuck" (Interview). Ed pointed out that this learning community would become his educational lifeline during those moments when he could not figure something out for himself.

When Ed evaluated the effectiveness of professional learning, he was primarily concerned with the extent to which it aligned with the content or standards of teaching mathematics. It had to be relevant or applicable to the courses he was teaching. He explained that he valued real-world applications in that they provided a "wow" factor or answered his students' questions of "When am I ever going to use this?"

Once such application that provided both the "wow" factor and an application of mathematics to real-world contexts was fractals. Ed stated that twenty years ago fractals were the "the big, new thing," and his students were interested in learning more about them. During that time, he attended a session presented by someone who had made a lot of money patenting various applications of fractals within the computer industry. When he relayed what he had learned to his students, the application of fractals hooked his students into learning other topics they were discussing in class. "Yes! They were fascinated" (Interview). Ed used the knowledge he gained about fractals and fractal applications from his professional learning experience to motivate his students and to illuminate various applications of mathematics to the real world. Based on his students' positive feedback, this was a story that he continued to use over time.

Positive and Negative Learning Experiences

Ed's positive professional learning experiences were blended with his explanations of how he learned. Although he learned from his students' feedback and collaboration with his peers, he spoke the most favorably about attending state and local

conferences with Ellen. These conferences were often hosted by the National Council of Teachers of Mathematics (NCTM), Texas Instruments, or school organizations that he recognized to be exemplary. State and national conferences allowed him the opportunity to learn, share, teach, and give back to the community of mathematics teachers and educators through collaboration. During a follow-up interview, Ed explained that he and Ellen looked forward to attending these conferences each year. They both viewed the professional excursions as vacations, and they chose to annually invest in these experiences to travel, to learn, and to reconnect with "old friends." Having become conference presenters themselves, Ed felt he was valued within a larger, national community, and these workshops gave him a dynamic way in which to collaborate and form meaningful friendships with those who share his passion for teaching mathematics.

During the interview, Ed indicated that he was most critical of the professional learning offerings provided by his administration or school district. Specifically, he found that when a session's goals were too broad, including topics that were presented to mathematics and non-mathematics teachers, often the presenters did not articulate how to implement their strategy within a mathematics classroom. He took the photograph depicted in Figure 27 of a poster that asked, "When are we ever gonna have to use this?" to illustrate that mathematics teachers need to understand how to apply professional learning to the real contexts of their classrooms much like students desire to learn how mathematics could be used within the contexts of real-world applications.

Ed believed that one of the problems with education is that "we tend to operate on two planes" (Interview). He explained that administrators or "people in power are telling

you as a teacher you should go differentiate in your classroom," but those who were providing the professional learning on differentiation were not modeling differentiation, nor were they providing additional support or information about to implement the

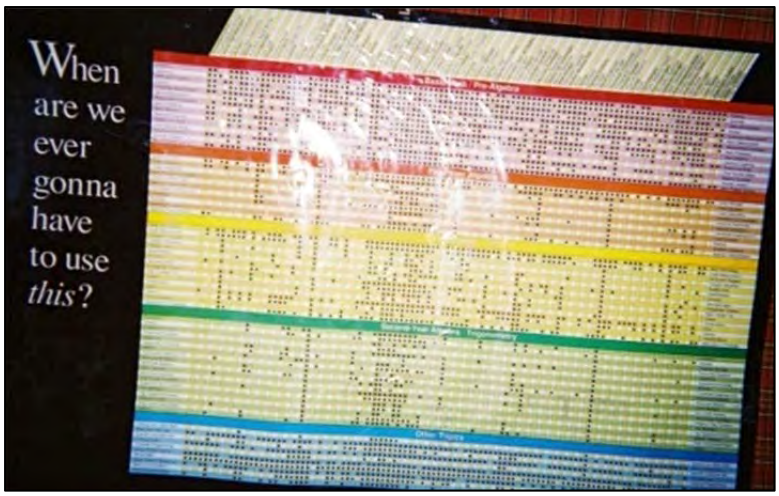

Figure 27. Ed's Photograph of the Poster that asks, "When Are We Ever Gonna Have to Use *This*?"

strategies into a mathematics classroom. He asserted that administrators promoted general strategies, like differentiation or literacy, school wide to an entire faculty, and required all of the teachers to use the strategies. However, unlike other content areas such as English, Social Studies, and Science, session presenters did not specify how to implement differentiation or literacy strategies into a mathematics classroom. When the mathematics teacher asked for additional information or support, Ed noted that the session facilitator usually side-stepped their questions and provided more vague responses.

> The answer invariably is "I don't know. Yeah. I can tell you what to do. I can tell you how to do it… and I can tell you how to do it in English, obviously. I can tell you how to do it in science. Social studies. But, gee, I don't know about math. But you need to be doing it." (Interview)

Ed criticized educational consultants who “have done their research. They have written their dissertation” and polished up an idea for self-promotion purposes. He posited that these consultants offered a solution that works within a very narrow and particular context, and then they falsely marketed the idea as a panacea for entire educational communities. “They package [the idea] neatly” (Interview), and then they go sell it to school districts. He felt that his school district had fallen for some of these ideas in the past and wrongly spent educational funds to attend conferences or to listen to speakers. Ed felt the process was a “self-promotional” money scheme that fooled his school district through “glossy” and “slick” ideas, and the district did not ask about the presumptions within a particular school setting or school district. From an educational leader’s perspective, he understood that new ideas being proposed by administration from the “top-down” would be a “tough sell” to teachers for a couple reasons. First, he asserted that teachers’ “backs instantly rile up” when they are asked to do something in their classroom without much contextual justification. Second, the administrator’s credibility is weaker than another mathematics teacher’s credibility because “they’re not in your classroom.” Therefore, teachers were critical of administrators who attempted to convince them something new because they had not taught mathematics. “I’m looking at you going, ‘Yes, but you taught social studies… And we know what you do in social studies. You watch films every day.’ … And, I’m trying to teach content one hundred eighty days a year in math and no one else understands and appreciates” (Interview). Thus, Ed believed that mathematics teachers view presenters and administrators who required them to change their instructional practices without justification or support for

implementation as unreasonable and disconnected from what goes on within the mathematics classroom.

Belief Systems

During the interview, Ed provided several examples that revealed a relativism position (Perry, 1968, 1999) of intellectual development. He exhibited that he acknowledged himself as a meaning maker, and often he considered a broader perspective of situational contexts in order to justify his responses. For example, Ed emphasized that he learns through problem solving, and that he wanted to be able to develop solutions even when he seeks others to scaffold the process.

> I want to kinda problem-solve it myself. I'm the kind of person who, if I can't get something to work on a calculator, and I get to the point where I come ask you, I don't want you to take my calculator, press the buttons, and say, this is what you do… I want, if necessary, some scaffolding and guidance to get there, but if I don't do it myself, I haven't done it (Interview).

Similarly, he wants his students to enjoy learning through the process of discovery and problem-solving. He taught in his preferred method of learning.

> When I've got kids with calculator problems, you know, I try to refrain from ever touching the buttons on their calculator… I want them to do some thinking along the way… That will help internalize what's going on. I want them to experience their voice. I want them to hear me saying things. I want them to visually be looking at the keyboard, I want them to be touching it… doing all your sensing modality. (Interview)

Ed's desire to problem-solve and to help others problem-solve was also demonstrated in his photographs. During the interview, Ed explained that as a Drama major, he valued symbolism because people interpreted photographs or poems differently. When he presented his trophy photograph, he pushed me to figure out his

thinking. After I probed further, he finally revealed his intentional correlation between the photograph and professional learning.

Figure 28. Ed's Photograph of Trophies

Rebecca: Why did you take a picture of the trophies?
Ed: Why do you think I took a picture of the trophies?
Rebecca: Well… coaching math, Math team… I'm thinking…why *did* you take the picture? I'm not going to put words in your mouth!
Ed: But this is symbolic. *You* should interpret the symbolism.
Rebecca: Okay. Am I correct in that perhaps it's maintaining a sense of excellence?
Ed: Yes. …That would be a good guess, yes. (Interview)

Figure 29. Transcript of Interview with Ed

Ed finally admitted that he did it to be "quasi-symbolic," and that as a Drama major, he grew to like and dislike symbolism. "Symbolism is interesting, but people try to put symbolic meanings onto things that doesn't [*sic*] always exist… I resent the fact that there is a quote, unquote right and wrong answer" (Interview). He asserted that if a he were an English student interpreting the meaning behind a poem, his teacher may tell him he is wrong; however, he believed the correctness of his interpretation was based on the validity of his justification. "It is not wrong if there is justification… And the only

person, I guess, who could say 'This is what I intended'… would be the author" (Interview). Likewise, Ed suggested that others may interpret his trophy photograph to mean that professional learning was of a "competitive nature" (Interview), yet he posited that professional learning was "collaborative and not competitive… [and] should be based on excellence" (Interview).

Ed expressed that his problem-solving nature may have frustrated other teachers with whom he had collaborated. He pointed out that some teachers only wanted him to provide solutions to them, even though he resisted doing so.

> Do they get frustrated with me sometimes because I don't? Yes, probably… 'Cause I think, you teach, to a large extent, the way you learn. Not completely, because you can force yourself to change… but I think to a large extent, most math teachers, truth be told, if you went back and looked, unless they made a real conscientious effort, probably are teaching the way they were taught in school. (Interview)

Through his role as department chair, Ed demonstrated during the interview that he was able to step back and look at professional situations from a broad view and consider different perspectives. For example, he described his department as being divided between two philosophies of time management. Some teachers left around 3:30 p.m. whereas other teachers left much later. Taking a global perspective on both philosophies, he explained why these different perspectives posed professional learning issues.

> This is not a one size fits all… You have some teachers who are only going to do things if it is, um, school time. So, therefore, it has to be on your common planning, it has to be on in-service days, okay? You have to provide a sub to take them out of class, that sort of thing. That's a fairly sizeable chunk of people. You also, then, have another group whose philosophy is very much, students is [*sic*] what is really important. I'm here for the students, okay? Yes, I want to do professional learning and all the rest of it, so it has to be on Saturdays, it has to be in the evenings. It

> has to be any time that's not being taken away from the students. Well, those two [groups] don't overlap. (Interview)

Ed implied that those who worked later into the evening maintained a more student-centered philosophy of education because they wanted to prioritize their time with students over professional learning time. Furthermore, Ed recognized that some educational solutions differed as he rationalized various situations or contexts. For example, he stated that there are "different settings, when you deal with administrators with, from curricular content, and all the other aspects of teaching" (Interview). He emphasized that, in terms of discipline or tardiness, the same rules should be applied "across the board" (Interview) for consistency. Yet, "when you talk about curricular things, you really need to be looking at how every curricular area is different" (Interview). As the department chair, he believed that his department would change "because you're going to have different people, and they're going to have different personalities and different experiences" (Interview).

Although Ed did not display mistrust for authority figures, he did recognize how different administrators may or may not ask for his input when teaching openings are available within his department. Ed explained that with previous principals, he would have a greater role in the hiring process in that he and an assistant principal would "interview the candidates we liked… [and] would then recommend. The principal would usually interview or whatever, and he, ultimately, of course, made the decision." With Ed's current principal, the process has changed. Ed stated that the current principal "does it all totally himself… I can send him names… but he's basically going to do the interviews. It's a different philosophy." He acknowledged that the current principal's most recent hires were "both excellent," but Ed still questioned the process.

Ed's perspective on learning and teaching through problem-solving demonstrated one of the characteristics of the progressive educator ideology (Ernest, 1994). Progressive educators assume that mathematics should center on creativity and self-realization through mathematics. Ed hesitated to give too much help to students and teachers when they were problem solving because he wanted them to discover the solution for themselves. He viewed his students as problem-solvers. Therefore, he disagreed with the philosophy that teachers should post Essential Questions or mathematical standards on the board. Ed claimed that "you don't have them discover things by telling them, when they walk in the door, what it is you're going to discover."

Ed also espoused that professional learning should be mathematics-specific, contextual, and "fun" (Interview). He used the photograph of a previous student's artwork (see Figure 30) to illustrate his perspective. Ed highlighted the artwork because he said was a personal item that a former calculus student made for him. He explained that it related to professional learning in that "it's mathematical… It is a different way of looking at mathematical concepts… Because it's not just 'Here find this area' sort of question, which is what your traditional problem seven in your book would look like" (Interview). Ed pointed out that she contextualized the mathematics, and that it was "very light-hearted and fun" (Interview).

Ed asserted, "Professional, student learning—whatever the case is—all learning should be fun" (Interview). As he sought out professional learning for himself, Ed noted that he desired knowledge or skills that he can "take back and use in my class, because it

Figure 30. Ed's Photograph of Student Artwork

might be something worthwhile for the kids. Or it might just be something that I would find interesting to learn" (Interview). During a follow-up interview, Ed asserted that attending professional learning with Ellen during the summer felt "more like a vacation" because they visited with all their "old friends again." Together, Ellen and Ed saved up for these experiences and traveled to state and national conferences to learn about teaching and learning mathematics.

During the interview, Ed delighted in providing me his photographs, encouraging me to reflect on his symbolic meaning. He thrived on providing opportunities for others to construct their own knowledge. For him, even during the interview, he took this progressive educator view on teaching and learning mathematics.

> Most of the others, I won't say they've embraced it, necessarily, whole-heartedly, and maybe it's because we have, because of me and Ellen and [another teacher], and the fact that we have a number of [teachers who attend and facilitate state and national conference workshops]… who have always been doing labs and activities, and stuff, and sharing and coercing them somewhat, in some cases, to do things, but they've been a little bit more prone to think of math classes as having activities. There is a place for labs and things, although they may still be basically a teacher-centered, you know, classroom, they know and have seen it in action, know it exists, um, and so, it was not a totally radical sort of philosophy for them.

In terms of his perspective of helping his students, he took a more person-centered caring approach. “It doesn’t matter how good, how bad your kids are, your job is you’ve got to go to their level and pull them up with you.” He stated that he posted his sign to be a gentle encouragement to teachers, and remind them that sometimes they need to change their instructional habits in order to help their students learn mathematics. In terms of collegial relationships, he asserted that teachers should humbly share their stories, wisdom, and materials with other teachers because sharing knowledge was “the right thing to do.”

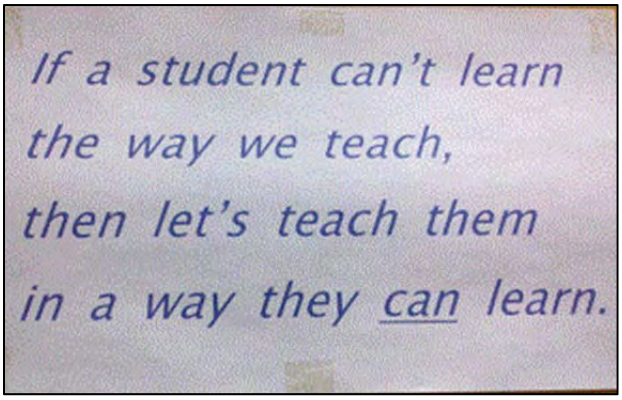

Figure 31. Ed’s Photograph of a Departmental Poster

> If we have something that we think we’re doing right, that others can use, we want you to have it, to use it, so your kids are going to do well too… For a lot of us, education’s important, the kids are important, it’s “What can we do to make the learning experience the best possible for everybody involved?” (Interview)

Furthermore, he believed that helping newer teachers learn how to teach mathematics was a “give forward kind of thing… As the experienced person… part of your job is to lay the ground work for the folks who need to come in after you to take your place.” Ed noted nurturing the students’ character was also an initiative of his school. One of the photographs presented was of Site 2’s Teacher of the Year display.

Figure 32. Ed's Photograph of the Teacher of the Year Plaque

Ed pointed out that the initiative started several years ago "to recognize good things… Star Students, we want to recognize valedictorians, [and] Teacher of the Year and post them in a prominent place… These are the things we value." Therefore, through Ed's testimony of his philosophy of teaching and learning mathematics, professional learning, and the development of students' mathematical problem-solving abilities and character, Ed's ideological perspective of teaching and learning mathematics most resembles that of a progressive educator (Ernest, 1994).

CHAPTER 11: ELLEN'S PROFESSIONAL LEARNING PROFILE

Background

Ellen, a 56-year-old Caucasian woman, taught for 33 years, of which 29 were at Site 2. As previously stated, Ellen and Ed are married, and did not have any children. With Bachelor's degrees in both Physics and Mathematics, Ellen spent her early years teaching physics at a small, rural high school near her hometown. After a few years teaching, she earned a Master of Education degree in Mathematics Education. She also earned additional teaching endorsements such as gifted certification and a Teacher Support Specialist certification (TSS). During the time of her interview, Ellen indicated that she was considering retiring within the next 10 years; however, during a follow-up interview, Ellen revealed that her mother was ill, and she was now considering an earlier retirement in light of this personal circumstance that had unfolded.

Ellen had received the honor of Teacher of the Year multiple times and coached Math Team. During her summers, she traveled with Ed to state and national conferences. She described the summer excursions for professional learning as "more of a vacation—not just professional development. We are among friends, and look forward to it each year" (Follow-Up Interview). Indeed, Ed and Ellen frequented mathematics conventions so often that they were both asked to present sessions on a myriad of topics from technology integration and problem solving to educational reform at a variety of conferences. Additionally, Ellen and Ed both retained leadership positions within the professional organizations as a result of years of active involvement within the

associations. During the time of the study, both Ed and Ellen were developing summer workshops that offered support for teachers adjusting to state-wide curriculum changes.

Photographs

Ellen was the only participant in the study who chose not to take photographs of her perspective of professional learning. Ellen indicated that imagining professional learning without people was very difficult. Therefore, she opted to look for her images online, and then she embedded them into an electronic document. She included a typed reflection with each image, explaining how the image related to professional learning. In all, she chose eight images, three of which were her "doggie" (Interview) cartoons, with the other six being advertisement banners for conferences related to professional learning for mathematics teachers.

Prior to the interview, I asked Ellen to pick her top four images to discuss further (beyond her initial reflections included in the electronic file). Her top picture (Figure 33) was a cartoon of 12 "doggies," each with unique personalities, in different shapes and sizes. One doggie, dressed as a king, wore a crown and robe, as other dogs sniffed the ground, sounded a trumpet, or held up a sign. Ellen explained, "People have different needs at different stages of their professional development, and so PD needs to be flexible and all encompassing, and ready to meet the needs of different people at different stages of their career" (Interview). In her written explanation, she noted that "PD should be flexible."

Ellen's second, third, and fourth choices all pertained to specific workshops that she had attended, planned, or helped organize. In her written explanation, she pointed out that at different stages of her career, she needed different types of professional learning to

Figure 33. Ellen's Image of Various Doggies

fit her needs. She had recently attended the National Council of Teachers of Mathematics (NCTM) Institute on Reasoning and Sense Making to better prepare for her state's curriculum reform that was underway; however, prior to the session, she attended a Texas Instruments-sponsored workshop called Teachers Teaching with Technology (or T^3) in order to gain technological skills. Primarily, Ellen's images supported her vision of flexible professional learning as the sessions varied content to meet Ellen's different professional needs.

Perspective of Learning and Teaching Mathematics

Although Ellen did not participate in the Professional Learning Discussion Board or the Professional Learning Journal, during the time of the interview, she provided additional artifacts including tasks, worksheets, and small three-dimensional student puzzles that helped me to more fully understand her perspective of teaching and learning mathematics. Additionally, she attached a copy of "George Poyla's 10 Commandments for Teaching Mathematics" to her survey. On the copy of the Commandments that she provided, she inserted her own amendments to the first, second, fourth, fifth, and tenth commandments. Her additions are italicized below.

1. Be interested in your subject. *Be interested in your students.*
2. Know your subject. *And know your students!*

3. Know about the ways of learning. The best way to learn anything is to discover it for yourself.
4. Try to read the faces of your students, try to see their expectations and difficulties, put yourself in their place. *Remember when you've been a student!*
5. Give them not only information, but "know-how," attitudes of the mind, the habit of the methodical work. *Force them to think and to organize their thoughts.*
6. Let them learn guessing.
7. Let them learn proving.
8. Look out for such features of the problem at hand that may be useful in solving the problems to come—try to disclose the general pattern that lies behind the present concrete situation.
9. Do not give away your whole secret at once—let the students guess before you tell it—let them find out themselves as much as is feasible.
10. Suggest it, do not force it down their throats. *Let them make the great discoveries and never say anything a kid can say!*

When I asked her which commandment was her favorite, she admitted that the first commandment, being interested in your subject, was the most important. "If you don't like math, your kids know it. You know? And I love it. I think it's fun" (Interview). She described her own experiences as a student of history, English, or mathematics with teachers who loved their subject. She explained that their love for the content they taught inspired her want to love the subject as well. She described during the interview how her 8th grade history teacher "made an impact" on her. "I thought for a while, maybe I should do something with history because he loved that subject so much. You could see it. He came in loving what he did. He was good at it" (Interview). Then, Ellen indicated that she was taught by a mathematics teacher who "loved math just as much" (Interview), and she realized that she loved mathematics as well. Although her English teacher loved English, she "never did pick up that love" (Interview), but she recognized that she still learned about literature and writing. Fundamentally, Ellen believed that all students deserved to have teachers who loved their subject.

All of Ellen's additions took into account her students' perspectives. She professed that connecting with her students as human beings and learners was important to her. For example, at one point in the interview, I asked Ellen if she was interested in reading scholarly articles related to learning theories of professional learning. She candidly stated, "not much," indicating that she did not want to devote her time to it. Ellen enjoyed reading when she had the spare time, but she did not enjoy reading for professional reasons. She read to escape her world and to relate to her students.

> My favorite reading has been when my kids were reading… I read Harry Potter. When my kids were reading the Twilight series, I took that summer, and I read the Twilight series… I like to keep up with what they've done. So I feel like I want to read something… that I can communicate with my kids about as opposed to teachers about learning styles. (Interview)

Ellen made concerted efforts to connect with her students in other ways. She stated that as she demonstrated her interest in their world, her students inferred that she cared about them. She suggested that caring about students' interests was as simple as chaperoning prom, going to sporting events or dressing up for school spirit days. "If it's PJ day, wear PJ's…. Because if they care about it, and they know you care about it, they get this transference idea that you care about them" (Interview).

She most enjoyed working with students who wanted or needed to know why things work or how things connected in mathematics. She felt that teaching mathematics through discovery was a natural part of her teaching style.

> I've always felt like you need to explain to students or let them discover, one way or the other, depending on where they are in their career, um, why things work. Because to me, mathematics isn't fun unless you know why… If you teach the lower level students, they've *got* to know how or why or they don't get it. They really need to understand it. A lot of the average kids really don't care. They want to be able to do it. (Interview)

During the interview, Ellen provided several examples of when and how she implemented discovery lessons. In one example, Ellen helped students use applications of matrices to solve problems that were applications of probabilities. She described one lesson in which the students investigated survival rates of three artillery tanks that were battling in a war. Each tank was a different size and had different success rates of surviving. Through the lesson, her students developed the rules of war, and ultimately, they decided that the two bigger tanks could not pick on the smallest tank. By the end of the learning task, students were able to justify, mathematically, that one should "never pick on the little guy" (Interview) because he was typically the last tank standing. She also described another activity in which her students discovered "power series that looked like e, sine, and cosine." Through the two-day exploration, she gave them assignments that posed questions to foster student connections between sequences and series and trigonometric forms of complex numbers. She asserted, "They discovered it, and it was amazing" (Interview).

In addition to facilitating the discovery process for her students, Ellen also felt that differentiation was in important aspect of her instruction. Ellen believed that differentiated instruction meant that educators should give extra help, assignments, or assessments to students needing additional support. Ellen explained her rationale for differentiation in terms of a medical need. "If one person in a room cuts their finger, they're going to need a Band-Aid. But you don't need to give a Band-Aid to everyone else in the room" (Interview). To that end, Ellen pointed out that "only certain students need Band-Aids… It's not an issue of fairness. It's an issue of need" (Interview). She believed that when both educators and students recognized that this type of differentiation

was okay, teachers would have a less difficult time getting students to "where they need to be" (Interview). She suggested that one way to meet the needs of reluctant learners was to use strategies promoted particularly for gifted students. "What works for a gifted child will work for all others. A lot of those teaching techniques, a lot of those expectations, will work not only for the gifted, but will also work for your reluctant learners, and should be used on your reluctant learners" (Interview).

Ellen's High Expectations for Students

Ellen stressed that she maintained high expectations for all students because she envisioned her students as adult learners. For example, she believed students in lower-level classes could mature mathematically after they graduated, and therefore, her role as their teacher was to provide a mathematical foundation on which they could later build or enhance their knowledge. She recalled running into one of her former "reluctant learners" (Interview) at the mall after he had graduated from high school. The student revealed that as a college student, he had just completed a calculus course.

> If I had not taught him just as hard as I did any other kid, he would not have had the geometry background to do calculus. But he did, and he could. And, he made an A. It just took him a little while to realize that maybe he ought to work a little harder than he was in high school… Late bloomer, but a darn good bloomer! (Interview)

She also encouraged her "best students" to teach mathematics if they loved and understood it. She told these high-achieving students that they "owed it to society to come back and teach" after they made their "second million" (Interview). She felt that in the real world, these students would realize that working for other people failed to offer the personal satisfaction that teaching provided.

To Ellen, one of the most challenging aspects of teaching was helping her students to be attentive and retain their learning long-term. She observed that her students' attention span had become much shorter compared the students she had taught years ago. She attributed these changes to advances in technology and how her current students were able to retrieve information.

> They know they can get more information quickly, so I think long ago, people kept things in their long-term memory for longer times and short-term memory for longer times… Even through their own personal discovery, or through reading, or any of the other varied techniques that we use, because you have to use different teaching techniques or you don't reach all your kids. (Interview)

Ellen believed that students were no longer ashamed of forgetting what they had learned. "I think a lot of the things that they learn they forget quickly. And they're very willing to admit it." She described how recently her students had discovered that they could find the area of a triangle by using matrices. "It was awesome. They thought it was the coolest thing in the world" (Interview). She explained during the interview that on the following day, she gave them a warm up and asked them to use the same method. She recalled that one of her students announced to the class that he had already forgotten the method. She chuckled in the interview and pointed out that her former students may have forgotten in the past, but they would have made up an excuse as to why they could not do the problem. "These days, it's 'I just flat forgot,' and they're willing to admit that. So, they don't remember things as long even when they discover 'em, which is annoying" (Interview).

Frustrated by the challenge, she admitted that her big question, for a long time, was to figure out how to help her students retain what they had learned. Then she revealed that she struggled with attention problems herself. "Being somewhat ADD

myself… this is something I really have to work on, because my kids can get me off track in two seconds. And it's hard, you know, I've got to really concentrate" (Interview). She explained that she had researched the issue, and she still did not have any solutions to the problem. "I don't want you to think I'm totally… educationally illiterate. I'm not. I've read studies that also show this is true. There are studies that back up the fact that there's a decreasing attention span. There are. Now, I don't know what to do about it" (Interview).

When I asked Ellen to describe an exemplary mathematics teacher, she reflected that she was struggling to answer the question. After I removed Polya's Commandments from Ellen's eye-sight, however, she asserted that expert teachers should be flexible "because you've got to be able to change, to meet the needs of the kids, wherever they are" (Interview). Ellen discussed how her very first principal left a lasting impression when he described that when educators work with students who struggled, they should "reach down, and find them where they are, and bring them up to where you want them to be" (Interview). She argued that complaining about students' lack of knowledge will not help the students be successful. "It's not their fault… You've got to do the best you can with them" (Interview). I took the photograph in Figure 34 of the student-made poster of "Creativity & Flexibility." She had the poster taped just above the inside of her classroom door. Ellen explained that she felt that good problem-solvers in her class must be creative and flexible in their way of thinking. As the poster notes, creativity means that students should be clever, imaginative, and inventive. Flexibility is important as students are able to adapt and be versatile during the problem-solving process. This

photograph is important in Ellen's profile as it typifies her characteristics of teaching mathematics and embodies her vision of an expert mathematics teacher.

Figure 34. Researcher's Photograph of a Poster above Ellen's Classroom Door that Read "Creativity and Flexibility"

Ellen also believed that expert teachers should have a thorough and dynamic knowledge of the curriculum. "To be the quintessential math teacher, you've got to know your subject well" (Interview). She believed that expert teachers were well-versed in their subject and understood the curriculum that led into and built from the content matter. Ellen described expert teachers as "comfortable with the area in-between" (Interview) who know "the stuff on the sides" (Interview). She believed that a strong knowledge of the curriculum allowed teachers to have the wisdom to know whether mathematical sidetracks in class are paths worth taking, or whether they should redirect the discussion to get their students back on track. "There are a lot of ways to get from A to B, and despite the fact that we, as teachers, may think we have a path, our kids don't see that path ahead of time. And, they're willing to shoot onto another one." Initially, Ellen proposed that teachers were "linear thinkers" who struggle to think outside of the box. Then, she changed her mind, and stated, "Oh. I take it back. Many times we do, but we need to encourage our students to think outside the box" (Interview).

When I asked her whether she thought she was an expert teacher, she suggested that her vision of expert mathematics teachers was that they had good teaching days *every* day. Although she strove to be an expert teacher, she felt she had not professionally reached that point even though she believed that other teachers viewed her as an expert. Ellen noted that "good days" (Interview) occurred when she incorporated all of the Process Standards in one lesson, such as when her students discovered the Power Series during class. After she detailed how the students worked together to make broad mathematical connections to advanced calculus topics, she happily pointed out that her students were using each of Process Standards.

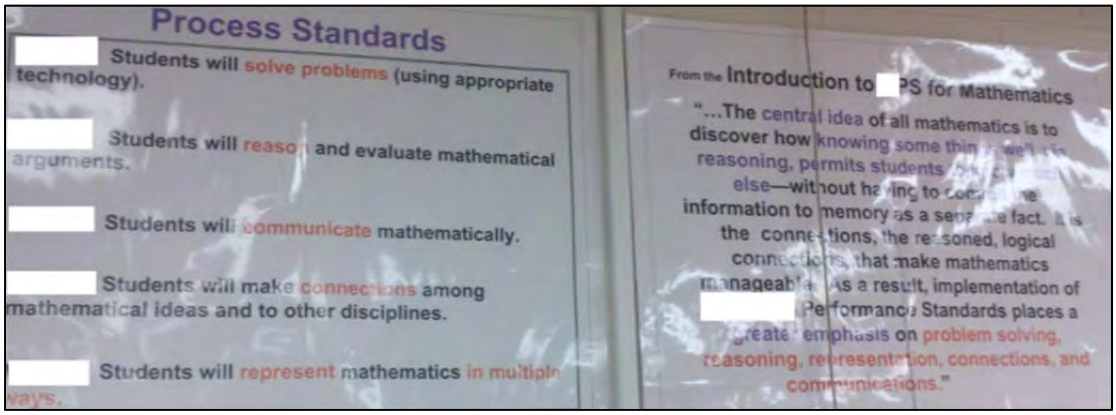

Figure 35. Researcher's Photograph of Ellen's Process Standards Posters

During the interview, she was so excited about her story that she stood up and pointed to her Process Standards poster that hung on her wall. Using a student perspective, she described everything that her students did during the lesson.

> I'm reviewing number sense. I'm getting to make conjectures, reason logically, oooh, ooh, wait, wait! Solve problems, communicate mathematically, make connections, represent mathematical— [Ellen pointed to the Process Standards that were posted on her wall]. So *that's* the kind of lesson I wish I had every day. Do I? Oh, heck no. But some days are good! (Interview)

Although she loved the Power Series task, she was disappointed that the mathematical content in the task was not in the class's curriculum. "So when push comes to shove, that one, unfortunately gets shoved out." However, she made every effort to include the activity each year because she felt that it addressed the esoteric needs, not curricular needs, of her students. She wanted them to have the joy of making "beautiful discoveries on their own" (Interview).

Professional Goals

Ellen's professional short-term and long-term goals were related to her interest in her state's new curriculum because she wanted to observe whether it would truly produce better problem-solving students.

> Short term, I would like to learn enough about the methods and ways of [her state's curriculum] to be able to transition my students next year from 8^{th} grade to the 10^{th}… Long term—and I'm working on this right now—I would like to see the entire flow of the [new curriculum], and if it's really going to create the type of student we want to come out of it… Because I think we are still in the position to make that happen for our kids if we look at where they've been and where they're going. (Interview)

She wanted to teach long enough to observe the effectiveness of her state's curriculum reform, and to determine how teachers should adapt to the new curriculum to make the transition more effective. Because her state was still gradually transitioning to a new curriculum year-by-year as students move from one grade level to the next, Ellen expressed that teachers were in a position to "make it happen for our kids" by utilizing their knowledge of what the students had learned, what they were learning, and what they would be learning in their next mathematics course. She was interested to find out whether the reform would effectively produce problem solvers or whether teachers needed to adapt to the process in order to make it more successful. "I really want to see if

that will work, or what kind of twinges we need along the way to be able to make that work" (Interview).

When Ellen discussed her learning needs, she thoughtfully reflected about how her learning needs had changed over time. She recognized that when she first began teaching, her learning needs were different than her current needs. When she first began teaching, she recalled, "Bless their hearts. I wasn't very good at discipline at all. I'm still not. But that was the thing I really felt I needed to focus on" (Interview). She wanted to learn more about discipline management at that time because she felt that was her greatest weakness. However, her learning needs have changed. She no longer wants to focus on discipline "because if I haven't figured it out in this time period, I'm not going to do it" (Interview). She expressed that during the time of the study, she was most interested in helping her students make mathematical connections. She also wanted to be exposed to more technology and to learn something innovative, creative, and new.

Motivation to Learn

Different professionals influenced Ellen to learn. However, Ellen described the suggestions of others more as "gentle nudges" (Interview) than mandates. In her written explanations of her photographs, she asserted, "Good leaders should gently guide teachers to the PD that might help them best" (Written Explanation of Professional Learning Images). For example, she discussed how a former department chair approached her about pursuing a Teacher Support Specialist endorsement. Although she was surprised by the suggestion, she also appreciated that the department chair recognized her strengths. Ellen noted that the department chair made an effort to approach each of the mathematics teachers and to suggest summer courses that she

thought personalized the learning needs of each particular teacher. Ellen appreciated this effort, and commented, “I thought that was incredibly perceptive of her to look at us, and if we weren’t ready to do it on our own, tell us what we need to be doing. I took it as she cared enough to help me grow” (Interview).

Ellen also admitted that her administration “for better or worse” developed some of her learning goals. Although she admitted that some of the professional learning sessions exposed her to valuable strategies for teaching and learning, other sessions had “been terrible” (Interview). In particular, Ellen attended her county’s required workshops to demonstrate technological proficiency. (This was the very same workshop that Betty enjoyed.) Ellen resented having to attend. “I thought it was the stupidest thing I’d ever taken in my life… I’m teaching technology, and they want me to take a course that shows I know how to use it? I just thought that was horrid” (Interview). Although she acknowledged that some teachers probably needed the course, she expressed that she should have been able to take a proficiency test to exempt the class.

Ellen also took part in setting her own goals. She was motivated to attend professional learning sessions offered at various conferences to address her self-diagnosed needs. She recognized that when she wanted or needed to professionally learn, she set her own goals. For example, early in her career when she wanted to learn more about precalculus, she attended several conferences outside the state that addressed this goal. When she realized that she wanted to know more, she took AP Calculus, AP Physics, AP Statistics, and AP Computer Science courses just because she “felt that [she] needed to know more about these subjects” (Interview). She had no expectations for teaching these courses. In this case, she was interested in the precalculus content and its

connection to other courses. Ellen valued developing new knowledge through professional learning sessions, and when a session did not meet her needs, she tried something different.

Ellen also consulted with Ed when she began or left various forms of professional learning, primarily because Ed and Ellen attended most of the classes and conferences together. For instance, Ellen and Ed decided to go to graduate school in order to pursue Specialist Degrees in Education. They also explored educational opportunities from both state and national mathematics and mathematics education conferences.

Methods for Learning

Ellen preferred to learn with a close-knit group of people. “I would hope that we all realize we’re humans together… and, you know, work with each other on an interpersonal relationship. That would be amazing. That’s the way it ought to be” (Interview). Throughout the interview, she provided numerous examples of working with students, colleagues, and her husband in order to learn something new. “You learn from a lot of places. You have to be open to learn from everywhere” (Interview). She enjoyed the process of constructing knowledge with other people. She enjoyed learning from people who had as much or more knowledge than she did so that they could problem-solve together.

Graduate school verses workshops. During the interview, Ellen spoke of a time when she and Ed were going through a graduate program together. Together, they pursued a Specialist degree in Mathematics Education. Ellen expressed that she realized that her program was merely repeating the course content she had learned from her Master’s program. “Our college professors really didn’t have it. They weren’t doing what

we were doing. They didn't see what we saw every day. They didn't know what could help us be better teachers... We just felt that there was something missing out there" (Interview). Therefore, Ed and Ellen decided not to complete the program, and together, they sought out state and national programs taught by model teachers who truly understood their educational contexts. They visited conferences "done by excellent and successful high school teachers" (Interview), because they felt that these high school teachers could better meet their learning needs. "And they did, because these people were in it. They were being successful in what they were doing" (Interview). Ellen found that the conferences provided a great deal of information that was immediately transferable in to her classroom, "which is what we needed." Although she pointed out that many of the college courses "tended to say the same thing," she expressed that teacher-facilitated conferences allowed her to glimpse into the real classrooms of innovative high school teachers. "Our college professors were *here*... and we were seeing a snapshot, even when we shared, of what was happening here. And when we went out, we discovered what else could happen elsewhere. And I definitely think I grew a lot" (Interview). She simply needed a different perspective from teachers who were being successful in other contexts. She desired more exposure to new ideas, and she felt that learning from and with teachers who were successfully teaching high school students was more practical than repeatedly taking courses that offered the same content.

Ellen attended conferences that she felt addressed her learning needs. She discussed attending conferences or workshops when she was interested in technology or mathematical content. As she developed leadership roles within professional organizations, she hosted several summer professional learning sessions to teachers as

they learned to adapt to her state's curriculum reform. Therefore, she attended more national mathematics conferences in order to see how they set up their conference in general. In all of these cases, she sought specific models of excellence to embody her learning goals. She sought human models who she knew could teach her a skill or concept or model conferences to observe session structures that she could later replicate.

Collaborations with peers. In addition to learning from more knowledgeable peers, she also recognized that she worked well with other teachers who were "on the same level" (Interview). She suggested that professional learning experiences should provide teachers the opportunity to work with other teachers who had the same level of experience or content knowledge so that they were more likely to collaborate and problem solve. She pointed out that teachers were less willing to admit when they struggled compared to when they believed that "someone else is in the same boat" (Interview). Ellen believed that this commonality between their egos made teachers more willing to admit when they needed help. In contrast, Ellen proposed that when new teachers are paired up with expert teachers, they are ashamed to ask for help. She had experienced both types of relationships during her first year on her state's mathematics tournament committee. Initially, she wrote mathematical questions and showed them to a veteran member of the committee. She was mortified when he could "work my best problems in one second" (Interview). When she began working with a peer who was "on the same level" (Interview), Ellen noted that they worked well together. She expressed that she was more comfortable admitting when she could not work a problem, and was more willing to ask for help. Then she and her peer collaborated to solve it together.

Similarly, Ellen revealed that her favorite professional moments were shared with Ed. Once, she was asked to facilitate a workshop using technology that she was still learning. She agreed but got access to the resources prior to the conferences to "just play." She described a scene in which she and Ed learned about various graphing calculators' functions as they sat at their kitchen table.

> It was so cute. We got [the graphing calculators], and we were going to have to present something to them, like the next day. So we sat down at the kitchen table that night, and we started saying things like, "Oh! Look what it will do!" …We were like two kids playing with toys. It was so scary. Anybody who was a fly on the wall would have died laughing at us acting like little kids.

Ellen asked whether I had ever seen the movie E.T., specifically the boy who wanted to teach E.T. everything about his world. She suggested that the movie demonstrated how "We're all teachers at heart… We all want to share with people in our world. We all want to teach people" (Interview). She and Ed were no exception. That night at the kitchen table, they just wanted to share with each other what they were discovering about the calculators. She felt they learned a great deal as they figured out how to operate the calculator for different functions. "In the minute, we had to know it. We wanted to know it. So it was a desire, a necessity, and we had someone to bounce ideas off of. So to me that was perfect, perfect, professional development that day" (Interview). Together, these examples illustrate that Ellen sought out peers when she wanted to create knowledge or problem solve, but she also found mentor teachers, not professors, to be suitable role models for superior instructional practices. She attended their conferences and emulated their practices and attempted to adapt the strategies to fit her teaching style.

Accidental learning. During the interview, Ellen described two incidents in which the professional growth was unintentional. In one instance, Ellen attended several science teachers' workshops during the summer just because she wanted to see the science-perspective slant on mathematics. Through the process, she was exposed to her state's science standards. She exclaimed, "Dang! They're good!" She believed she viewed a lot of topics from a scientific perspective, and she asserted that many of the science standards were embedded into the 10th grade mathematics content. She reflected, "So now when I'm teaching certain subjects, I think, 'This could have a science tie-in. I can do that'" (Interview). As she taught summer mathematics courses, she began to point out how the scientific method was similar to the problem solving strategies that she had already been implementing. By participating in the summer professional learning workshops in which she focused on her state's science standards, she unintentionally enhanced her summer teaching. "I, as Bob Ross would call it, I had a 'happy accident.' How wonderful. Something cool happened, and we had a lot of happy accidents" (Interview).

The second incident she described was quite different. Surprisingly, one of her most significant learning experiences happened unintentionally during a parent-teacher conference. Prior to working at Site 2, Ellen student-taught at a smaller, more low-key school and was "mothered" by a nurturing supervising teacher. In retrospect, Ellen pointed out that she had more time to learn how to teach, and she was able to "do beautiful things" because her supervising teacher gave her a great deal of flexibility. However, when Ellen began teaching at Site 2, she felt that wasting class time was not an option. "You do not waste time here. They are much more serious about their learning"

(Interview). Therefore, as a new, young teacher, she made a concerted effort to teach bell to bell. After she taught this way for approximately two years, she attended a parent-teacher conference during which the parent revealed that her daughter was "scared to death" of Ellen. Ellen said this moment shocked and mortified her.

> I did not want to instill *fear*. You know, but I realized that I was so sold on the fact that I must teach bell to bell, I must keep them busy, they were afraid. And I loosened up a lot due to that parent conference. That was very insightful. And I guess you could call that professional development. (Interview)

Ellen elaborated that she would not have known to make the instructional change had not the parent said something. After that point, she began to be more open with her students. "I needed to get to know my kids a little better, and I think that's when this 'know your students' came into play" (Interview). She felt like she was able to keep the rigor of her course while loosening up with her teaching style. Ellen felt that after she gained respect, she did not need to be a "hard-nosed disciplinarian" (Interview).

Online learning verse workshops. Ellen described herself as "BC: *Before Calculators.* I'm a BC" (Interview). She was not a fan of online learning because she expressed that instructors did not deeply teach the content matter. She described an online class that she took to learn Microsoft Access. She felt she could utilize the powerful tool to help organize Math Team tournament scores and tournaments. She admitted that the online class taught her the basics of the program. However, she also recalled that she hit a technical snag with her project, and her instructor could not help her solve the problem. At that point, she turned to some of her students, and with their guidance, she was able to effectively tweak her project to make it work effectively. She used the program until she

discovered that other programs, like Microsoft Excel, were more user-friendly and served the same purpose.

Ultimately, she feared that online learning was becoming more of an educational trend in professional learning as well as in learning and teaching mathematics. She felt most teachers used the Internet to address "in-time knowledge" (Interview) in an effort to make professional learning instantaneous. Ellen asserted that this approach to learning how to teach mathematics was problematic because teachers were learning to teach a topic the night before teaching it in class. Additionally, because she believed that her students also have the same access to the Internet, they are not as attentive in class. Ellen suggested that her students knew that they could also go home and research it "right now" (Interview) when they need the knowledge.

> In-time knowledge to me, it doesn't allow for the depth that you need… The kind of things we did, kids these days aren't going to do because it takes too long. Their attention spans aren't there. Are our attention spans much better?

She admitted that if she could not find out something by herself, she went online to find it instantaneously. "Let's face it. My cell phone can answer half of my questions" (Interview). Ellen pointed out that staff development was also changing as information became more accessible online. Although her state offers Webinars to inform educators about curriculum reforms, Ellen stated that "old-fashioned people" (Interview) like her reject this way of learning. "We can't ask questions to the machine and have it answer us, and we have questions that are outside the box of its knowledge. That's why we like working in groups" (Interview). For this reason, when Ellen and Ed had the opportunity to develop a series of professional learning workshops for teachers on a state-wide scale, they chose to offer summer teaching academies in which teachers could collaborate with

other teachers while receiving face-to-face assistance. Ellen revealed that the academies filled up because many teachers preferred to learn through academy-style sessions.

> Which brings us full circle back into the first one: it needs to be flexible. Cause we all have different needs at different points. So despite the fact that, yes, that machine is wonderful… There are going to be people out there who don't respond to it, who still need to be in groups and classrooms to hear other people talk to feed off of other people's ideas, which is the way I like to do this. (Interview)

Ellen asserted that learning needs were influenced by professional stages and teachers' learning needs changed as they progressed from one career stage to the next. She explained that her "doggie" picture illustrated that "people have different needs at different stages of their professional career" (Interview). Therefore, Ellen felt that professional learning opportunities should meet teachers' various needs through different modes of delivery. Although her school district embraced Webinars to deliver professional learning, Ellen argued that many teachers would not respond to it and preferred face-to-face opportunities to learn with others. She worked diligently to develop the summer academies to provide teachers a different and flexible type of professional learning to meet their needs through collaboration.

Ellen preferred to learn with other people. This was evident through her description of learning to teach precalculus in the early 1980's. At the time, she was a Math Team coach at Site 2, and a new teacher. Math Team tournaments provided opportunities for Ellen to network with other Math Team coaches from different schools in her school district and state. Within this unique community of teachers, she met two other teachers from her school district who were also teaching precalculus for the first time. "We were on the phone once a week" (Interview). She described sitting at home, surrounded by several mathematics texts, and determining the definitions, language, and

methods she preferred among them all. Then, she called her two colleagues to ask for their opinions about the resources and textbooks. Within this learning community, Ellen and the other teachers also shared tests and course assignments through their school district's county mail.

> It was fabulous. I felt like I was one of the most enlightened Analysis teachers, because I had two people working with me, making sure we taught it, more or less… I can't say the same way, because we all had our own slant. But we would at least talk about it, and get different ideas. And share resources. It was phenomenal. Um, why did we do it? I don't know, other than it was the first time for all of us. I think we wanted a friend, and at that point, no one was doing Pre-Cal seminars anywhere. So, we kinda felt like we needed to get together and look at it. We just did. (Interview)

Much like her early years of teaching, Ellen found herself learning to teach a new course when her state's new curriculum was implemented. In a similar fashion, Ellen spontaneously became part of a tight-knit learning community of teachers within her school district. Ellen explained that many of the teachers who were also teaching the new 10^{th} grade mathematics course convened informally, once a month, to discuss their classes, the curriculum, and the accomplishments of their students. She said that this learning community "saved all of [their] necks that year." She enjoyed the "phenomenal" (Interview) process of working with other teachers who shared her common need of teaching a specific new course. "The learning community was great" (Interview). When I asked her how the group formed, she said that she and several different teachers were just getting together to talk, and "it just kinda happened… We had fun. I know that much. It was an awesome thing" (Interview).

Both of these learning experiences highlighted Ellen's idea of a professional learning "utopia" (Interview). She explained that her ideal world consisted of four or five people who decided that they are going to teach the same lesson.

> Realistically, we all start by saying, we could do this. Someone gets online and says, "I like this, but I don't like this question." Then someone else could say, "That question's pretty cool, but I don't like that one because you're leading them into a response. Ask it this way instead."… But like four or five people could get online and create a beautiful lesson that way. (Interview)

According to Ellen, the process did not have to include all "expert people." Ideally, the group should be composed of teachers with different perspectives. "We're all coming at it from our angles. You know? And even experts can learn if they have an open mind to it" (Interview).

Positive and Negative Learning Experiences

Ellen loved learning, and she provided several different examples during her interview of learning with other people. In the following example, she discussed a positive learning process from learning to implementation to evaluation. After Ellen and Ed abandoned the Specialist Program at a nearby university, they decided to attend the Philips Exeter Academy Conference in New Hampshire, which took place in a New England private school. Ellen described the facilitators as "movers and shakers in mathematics education" (Interview). When she and Ed signed up for the conference, they were allowed to focus on two major areas. She chose to focus on art and geometry. Two facilitators, an artist and a mathematician, worked together to teach the workshop. Ellen noted reciprocity when the artist spoke of learning much about geometry; likewise, the mathematician learned a great deal about art. Ellen remembered that the expert emphasized the golden ratio and the golden rectangle by connecting both of these topics to art and mathematics. When she returned to teach the following school year, she was excited to implement a creative project in which her geometry students constructed geometry boxes.

> The artist talked to us about control and how you had to have creativity within constraints, and so, I had to tell them how their box had to be. So one side had to emphasize parallel lines. Another side perpendicular lines, and another side had to do this, and one had to have color. (Interview)

Ellen was amazed by how much creativity her students put into the project while also demonstrating their content knowledge. She stated that for a few years, her geometry students built boxes to display their knowledge of geometrical terms. Ellen pointed out that she enjoyed implementing the activity because she realized that she could still cover the curriculum and also allow her students to be creatively expressive. “I think that probably set that seed in my mind that any time I can let kids be creative with the mathematics they’re doing, it’s a beautiful thing” (Interview). From the Art and Geometry workshop, Ellen transferred what she learned from the session into her instructional practices. She used student feedback and the products of their work to assess whether the activity was worthwhile. For her, the conference introduced her to a new mindset of integrating art into her mathematics class. Ellen stated that her classes during the session “kinda brought it together” (Interview) for her.

In contrast, Ellen resented having to attend mandatory professional learning sessions that did not meet teachers’ needs. She recalled that once, her school district required all mathematics teachers in the district to attend an in-service during which they had to sign up for a workshop. During the conference, attendees were taught “teaching strategies from someone who had been an English teacher, and the strategies, we kept saying, ‘So, how do you do this in math?’ and she’d say, ‘Oh. I’ve never really done it in math.’ [Ellen sighs and laughs.] I learned nothing at the end of this” (Interview). Even though Ellen continued to press the instructor about the applicability of the strategy to a mathematics classroom, the instructor could not provide concrete examples. “Now, some

strategies… I can find a way, but whether this one was, I kept thinking at the end of the hour, what a waste of my time" (Interview).

As already discussed, Ellen resented going to a technology workshop in order to demonstrate some level of technology proficiency. She claimed she had already taught technology classes at various conferences, and she was frustrated that she was not offered another alternate method demonstrate her proficiency in technology. In the other example previously mentioned, Ellen posited that her school district imposed a one-size-fits-all approach to professional learning that isolated the teachers within her mathematics department. With the technology workshop, she was among many employees who were required to attend the workshop regardless of their actual level of proficiency. The other workshop provided at her school promoted general instructional strategies in which the presenter assumed the lesson's applicability would be obvious for most teachers; however, Ellen felt that the facilitators did not and could not clearly link the strategies to effective practices for teaching mathematics. Ellen expressed frustration with both types of professional learning experiences because she pointed out that the experiences did not meet her needs as a mathematics teacher, and the intention of the professional learning took a general stance—not a differentiated approach—to teacher education.

Belief Systems

Through her descriptions of teaching and learning, Ellen provided several examples indicating that she learned through constructed knowing (Belenky et al., 1986). Her position on her understanding of truth also demonstrated that she recognized and understood truth to be contextual, and she solved problems by considering multiple perspectives. For example, Ellen's response to an interview question in which she

articulated the difference between professional learning and professional development demonstrated the dynamic way she constructed knowledge. Ellen thought about the question from every possible angle, then she reflected, asked, and answered her own questions, and ultimately drew a conclusion.

> Do you learn as you develop, or do you develop as you learn? Hmm… Development implies growth, in several areas. Learning implies attaining knowledge. So, yes, I think they are different. I think they go hand-in-hand to a point. You're always learning, though. What I'm trying to figure out is, you should be always learning. I'm trying to think of other ways you can think of development. My muscles develop as I exercise them. Are they learning anything? Not necessarily. If I learned about bugs, does that necessarily mean that I've developed at all? Possibly, but in a different way. (Interview)

Ellen sought to connect with other teachers who understood her educational contexts, sympathized with her struggles, and shared common professional learning interests. She looked to work with teachers to construct knowledge, and she preferred to learn from teachers during professional learning sessions. In the document of her digital images and explanations of the images that she submitted to me, she asserted that professional learning was "best delivered by other teachers who have experienced the same situations and met with success." This rationale illustrates why Ellen expressed that her college professors "really didn't have it… They weren't doing what we were doing. They didn't see what we saw every day" (Interview). She sought "excellent and successful high school teachers" (Interview) who better met her professional learning needs. As a learner, she sought to create knowledge and learn from those who understood her context, and she geographically broadened her professional learning options to find such learning communities. She pointed out that once she ventured to conferences and workshops outside of her state, she "discovered what else could happen elsewhere. And I

definitely think I grew a lot… I'm not sure my teaching techniques changed a lot, but the type of questions I would ask, did. I went deeper. I didn't think about going deeper until then."

Ellen stated that professional learning should help teachers make connections, create learning communities, and create new avenues to learning how to teach mathematics. In the document of her digital images and explanations, Ellen explained what she believed professional learning opportunities should offer teachers.

> PD should teach us something, renew our spirit and help make connections for us. Those connections could create a learning community—as part of a vertical alignment, a horizontal alignment or just a philosophical alignment. However, those connections could also be personal revelations—new ways to reach students or bridge a difficult topic to previous knowledge.

She viewed professional learning through a larger lens, noting that her professional learning needs were different in different stages of her teaching career. During the interview, she pointed out that during her first few years of teaching, she would have been more interested in learning how to improve her classroom management techniques. "I wasn't very good at discipline at all. I'm still not. But that was thing I really felt I needed to focus on because I knew that that was a problem" (Interview). She noted that her learning goals had changed, and she rationalized that if she had not "figured [discipline techniques] out in this time period, I'm not going to do it." The way that Ellen viewed her professional goals and discussed her professional learning vision illustrated that she understood the "truth" (Belenky et al., 1986) of professional learning to be tentative and contextual. In this case, she viewed her learning needs as dependent on the contexts of her career stage and her learning interests. Ellen also wrote in the document of her images and explanations of professional learning that the image of all

the different doggies related to professional learning in that “Just as people are different with different needs at different times, PD should be flexible as well.”

Figure 36. Ellen’s Image of Various Doggies

Ellen asserted that professional learning should also be dynamic to fit the needs of teachers depending on their career stage. This perspective illustrated that she reflected on the larger concept by taking a global perspective of how parts of the scenario were related. Ellen expressed that sharing knowledge, constructing knowledge, and helping others learn was the focus of her teaching philosophy. When other teachers with less experience approached her for professional guidance, she was compelled to share and help them out of professional obligation. “I appreciate the fact that I’ve been teaching longer than they have, and probably have more knowledge than they do… I’m glad to share all the knowledge I’ve got. If I could can it, I would give it to you. That’s part of the sharing resource we all ought to be doing.”

Ellen noted that she had recently spoken to a businessman who was a member of her state’s Math Team committee. She noted that he emphasized the use of collaboration in order to construct knowledge, and she posited that professional learning should be done in similar manner.

> He said the new philosophy on working together, on cooperative learning these days, is *not* "I know something and I teach it to you." It's that I say, "Can we learn something together?" And we all put it out on the table, and everybody looks at it, and we say, "I don't like that part." And someone else says, "I don't like that part." And you develop it together as a team… I feel like this could make professional [learning] kind of the same way. (Interview)

Through the multiple examples that Ellen discussed during the interview (i.e., learning Access from her students, learning about calculators with Ed, forming small learning communities when learning to teach new curriculum), Ellen illustrated that she valued multiple perspectives when learning, and that she felt a personal commitment to the learning and teaching process.

Ellen viewed her students has human beings, not empty vessels, and she asserted that she could learn from them and help them to become better problem solvers. Ellen's educational ideology mostly resembled a progressive educator (Ernest, 1994) because she took a student-centered approach to teaching and learning. Ellen's amendments to Polya's Commandments (provided in an attachment with her initial survey) highlight her student-centered perspective of teaching and learning. (Ellen's additional comments are italicized.)

1. Be interested in your subject. *Be interested in your students.*
2. Know your subject. *And know your students!*
3. Suggest it, do not force it down their throats. *Let them make the great discoveries and never say anything a kid can say!*

Figure 37. Sample of Ellen's Amendments to Polya's Commandments

She rationalized giving more help to some rather than others because she wanted to help her students avoid failure. "You need to reach down, and find them where they

are, and bring them up to where you want them to be because there's no use to complain about the teacher last year that didn't go a good job. You've got 'em now. Deal with them." She strove to challenge her students through activities and assessments to help students successfully "think outside of the box" (Interview).

Ellen pointed out that all of her assessments were out of more than 100 points. She was transparent with her students about how she constructed her assessments.

> I tell them… you will see questions on tests that have never been discussed in class… I need to make you think and grow, and the only way to do that is to expect you to take your knowledge and apply it to situations that you've never seen before. I won't give you anything you can't do, but I will make you put together things and make connections that I've never asked you to do before. (Interview)

Although she aimed to continually challenge her students, she realized that her students matured and learned at different rates. When describing one student who struggled with an item on the test, she described how she drew a box on her test and indicated that she knew she was supposed to be thinking out of the box, but she did not know how. Ellen thought this creative response was "the cutest thing" she had ever seen. Ellen stated that the student "knew she was supposed to do some out-of-the-box thinking, but she didn't know quite where to go… It was just a connection she couldn't see at the time… We all do that… But I do want them to draw as many little dendrites as possible" (Interview). Ellen demonstrated that she viewed students as "growing flowers" (Ernest, 1994, p. 138) as well. For example, when she recalled running into a former geometry student who had just completed his first calculus class, she noted that she helped him be successful, even if it happened after he had graduated.

> If I had not taught him just as hard as I did any other kid, he would not have had the geometry background to do calculus. But he did. And he could. And he made an A. It just took him a little while to realize that

> maybe he ought to work a little harder than he was in high school. Matured a little bit later. But that's okay. Late bloomer, but a darn good bloomer! (Interview)

She suggested that classes took on "their own personalities, depending on the students in them." She explained that she was able to adapt to the antics of difficult students because she is flexible. Therefore, her students are motivated to learn. "And I think that's a powerful thing to realize. As soon as you realize that if you work with those kids they're going to work with you, you've just made big strides in both your lives" (Interview). Ellen perceived each of her students as individuals who had different needs. Therefore, she differentiated for each student as they needed the help. Her Band-aid definition of differentiation illustrated that she believed that only certain students need personalized help.

> And as soon as you realize that, and the kids realize that, being able to get everybody to work at where they need to be gets easier… Because I can give them an extra worksheet, or a chance to bring up her average, without giving one to everyone else. And it's okay. It's not an issue of fairness, It's an issue of need. Which, I like that. That's differentiation in my book. (Interview)

With a child-centered perspective, she viewed her students has human beings and strove to present them with a rich environment in which they could problem-solve and explore. "We're humans together… and, you know, work with each other on an interpersonal relationship. That's the way it ought to be" (Interview).

Additionally, Ellen described several instances in which she embedded creative and exploratory ways for her students to learn mathematics and express themselves. She asserted that learning should be fun, and that students should able to learn through play, activity, or exploration. During the interview, Ellen implied that as her students deeply understood certain properties of mathematics, they were able to "play with it," and her

students perceived the property "as a toy." She described how her students discovered a formula, like the Pythagorean Identity, and were able to connect those properties to other topics.

> They can use it to show something's true on the unit circle. They can use it to find things in triangles. They can use it to find identities. So they see it more as a living equation they can play with and manipulate, and they're more comfortable with, and they can solve for the sine in terms of the cosine, and cosine in terms of the sine. They see it enough to play with it. They see it as a toy.

As Ellen described through different contexts, "playing" with mathematics became synonymous with problem solving or learning through discovery. "Playing" could also be a means of being cognitively engaged. She asserted that manipulatives helped some of her students make concrete mathematical connections to abstract ideas. She described her students learning about concepts by using their calculators. "They're playing with their calculators and exploring, and trying to figure out, 'How far can I go with this?'" (Interview). Ellen also showed me her shelving system of manipulatives. (Ed took the photograph of Ellen's manipulatives to include with his professional learning photographs.) As she showed me the various content of the shelves, she explained why manipulatives are an important mathematical tool for teaching.

> Manipulatives are amazing… We start concrete and go up to abstractions… If your kids are… not getting the abstractions, you've got to go back to something concrete… You know, a real world application where they can see it…. physically getting out stuff… paper folding, or manipulating… And I want all my toys ready at a moment's notice. (Interview)

Ellen strove to have her students play and explore mathematics through interesting activities, such as the previously discussed tank task, in which students created their own mathematical constraints as a class and worked together to solve the problem.

Figure 38. Ed's Photograph of Ellen's Manipulative Shelves

In the tank example, Ellen explained that her students used properties of probabilities and matrices to figure out that the smallest tank usually won the war. Therefore, "you should never pick on the little guy" (Interview).

She valued embedding creativity into her lessons. After attending a workshop on the connections between art and geometry, she described that she "did a lot more art in that informal geometry class" (Interview). She then explained that the activity was fun, it let her students be expressive, and it still allowed her to cover the curriculum. "I think that probably set that seed in my mind that any time I can let kids be creative with the mathematics they're doing, it's a beautiful thing. And, you see, it was just that workshop, that kinda brought it together" (Interview).

Creative assignments also allowed her flexibility in how she adapted the activities for her students. She explained that the same workshop with the class on art and geometry gave her the tools she needed to adapt other creative assignments into her instructional practices. She indicated that she attended a different conference during which the facilitator introduced a lesson to guide students to make parametric pumpkins. "And I remember going to that workshop saying, 'That was really stupid,' but I took the

handout, and I stuffed it in my file… I kept thinking, I would never have my kids do that, that's way too contrived" (Interview). She realized that her students were "having trouble understanding what parametric equations would do, and why we cared about them, what they were capable of, it dawned on me, they need a project" (Interview). Then, she took the parametric pumpkins project that she remembered from the conference and adapted it to have different constraints. For her, both professional learning opportunities were important because she asserted that professional learning should allow teachers "to be creative" (Interview). Therefore, through Ellen's stories of her own learning and her students' learning, she demonstrated that she believed mathematics should be personalized, child-centered, creative, engaging, and fun. Ernest (1994) pointed out that progressive educators believe education should "promote the self-realization of individuals by encouraging their educational growth through creativity, self-expression and wide-ranging experience, enabling them to reach their full flower" (p. 183). Ellen assessed her students' mathematical knowledge in creative ways (i.e., the geometry cube, parametric eggs, and tests containing bonus points) and differentiated her assignments to provide more opportunities for her students to be mathematically successful. Therefore, Ellen's ideology most resembles the progressive educator perspective.

CHAPTER 12: FINDINGS

As illustrated within the Professional Learning Profiles (PLPs) presented in the previous chapters, each participant maintained unique perspectives of the professional learning process, collaboration, goal setting, and concepts of teaching and learning. Within this chapter, I discuss commonalities among the participants' perspectives in relation to their views of professional learning, interactions with others, and the structure of professional learning to provide a broader picture of how relationship dynamics shape the process of professional learning. Although each participant's PLP provides a snapshot of his or her perspectives, taking a step back from the data to gather a global view of the results reveals commonalities in goal setting, participant buy-in, contexts for professional learning, evidence of learning, and evaluation of learning. What commonalities were shared across the participants' accounts? What were the differences and how do they pertain to the perspective of the learner? The four themes that emerged from the data analysis were: (1) establishing relevance for professional learning; (2) contexts for professional learning; (3) participants' valuation of time; and (4) desired resources for professional learning.

Establishing Relevance for Professional Learning to Professional Learning Goals

The theme of establishing relevance for professional learning emerged through the participants' descriptions of their professional learning experiences, their professional learning goal descriptions, and their thorough descriptions of expert mathematics teachers. Through the categories of: (1) imposed professional learning goals; (2) job

satisfaction and professional learning; and (3) participants' perspectives of expert mathematics teachers, the participants' descriptions of their goals and how professional learning addresses their goals are outlined. When creating this theme, I defined *professional learning relevance* as the degree to which professional learning experiences addressed the participants' professional learning needs or goals. Therefore, participants' descriptions of how professional learning experiences were or were not aligned with their needs are outlined. I also included the job satisfaction category because some of the participants were contemplating transferring to a different school, retiring, or leaving the teaching profession altogether. Therefore, the participants' broader professional goal may have been to change their professional context. Consequently, I asked myself, how can professional learning experiences be relevant to mathematics teachers who are planning to leave the classroom? Thus, the participants' job satisfaction related to their goals of continuing to teach mathematics in their school or school district. The participants' perceptions of expert mathematics teachers also related to their goals as they described a model of expertise as an attainable or unattainable goal. Within both of the categories of job satisfaction and perceptions of mathematics teachers, if the participants' goals were to leave the classroom or to reach an unattainable goal, relevance of the professional learning experience needed to also be outlined to set the stage for later discussion within the final chapter.

Imposed Professional Learning Goals

How learners engage themselves or others during the professional learning process influences whether they perceive it as a positive or negative learning experience. Many of the negative learning experiences described by the participants were mandated

by other individuals or entities. For example, Mary described how she attended a session in which she, and the rest of her school's faculty members, had to listen to a motivational speaker.

> I think that my worst learning experiences have been formal large group settings where everyone in the whole school attends during preplanning. At times, this has been a motivational speaker to start off the year. We're motivated, we've had the summer off, and we'd rather have the time in our rooms to get ready. (Blog Entry)

She was required to attend this presentation by some authority figure, most likely her administrator. She elaborated on this experience during her interview and asserted, "They're going to make me go sit and listen to an inspirational speaker… I think that it should be subject-area specific." In this case, Mary's goal was defined for her by an authority figure, and she criticized the relevance of the professional learning content to her practice. Once the presentation was over, Mary returned to her classroom and began to organize her materials and classroom for the upcoming school year.

Mary's experience was not unique. All the participants described attending required professional learning sessions for which goals had already been established for them. They noted that they attended a session, workshop, or presentation, and then they quickly criticized into the seemingly thin professional relevance smokescreen presented to them. Ellen, who was open-minded to various learning experiences and topics, described attending a session she believed as irrelevant to her practice.

> I kept saying, "So, how do you do this in math?" and she had no examples. And I'm sure they were great English strategies. Do not get me wrong, but I really dug and couldn't figure out why in the world I would ever want to do this in a math classroom… I kept thinking at the end of the hour, what a waste of my time. (Interview)

On the Professional Learning Discussion board, Laura wrote that her "worst learning experience" entailed attending a mandated professional learning session provided by her school district. The session facilitators demonstrated a software program that only a few mathematics teachers could actually use.

> If you don't teach statistics or just have a lot of extra time on your hands to learn the software, you most likely were not going to ever use this wonderful county purchase. The meeting was a complete waste of three and a half hours. (Blog Entry).

Likewise, Betty expressed that she was frustrated with mandated sessions that demonstrated mathematical software. For example, during the interview, she described a one-hour demonstration of how to use a mathematical software program as "a waste of time… It's nice to see someone else do it, but they aren't doing anything I'm going to use" (Interview). Betty also went on to recall attending a county provided session on the new curriculum that her state had adopted. She indicated that the professional learning session presenters only promoted task-based instructional practices that teachers were expected to use in implementing the state's new curriculum; yet, the facilitators did not clarify the curriculum standards of the course.

> I didn't enjoy doing it, and I wasn't going to teach it that way either… I think that from our community, we knew that we weren't going to teach that way… You had to go and learn it, and cascade it down. We did all that, and we *still* didn't know the content of what was gonna be taught in the course. All we knew was this is the way it's supposed to be delivered… Well, what are we going to deliver? Nobody knows… It was that it wasn't relevant to us being able to implement it the next year. And I think that you're gonna take teachers that really don't have much time you need to really target what they need. Get to it! (Interview)

Ed took the photograph of the poster in Figure 39 and expressed that "people in power" use professional learning opportunities to instruct teachers to implement

strategies. However, he stated that “whoever’s in charge” (Interview) was not modeling or using the same practices that teachers were expected teachers to use.

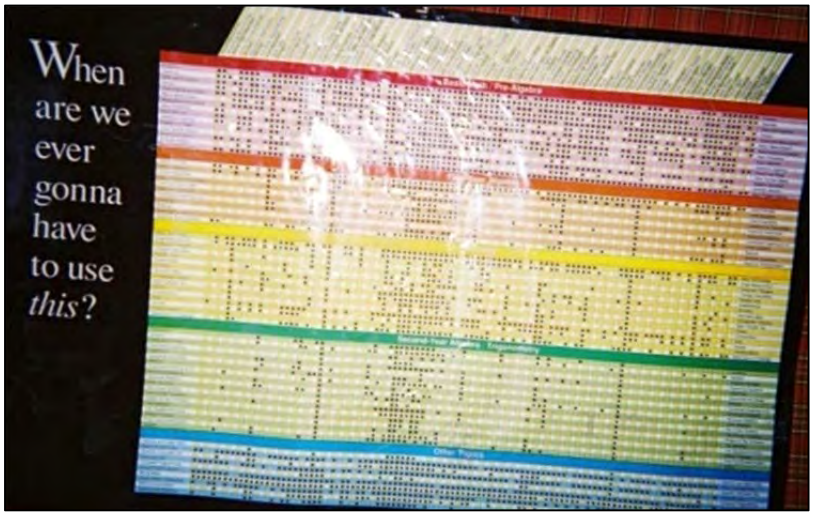

Figure 39. Ed’s Photograph of the Poster that Read, “When Are We Ever Gonna Have to Use *This*?”

Ed indicated that some professional development facilitators promoted some instructional practices that they, the facilitators themselves, did not model during the session nor did they explain how to implement the strategies within mathematics classrooms. For example, Ed noted that “people in power” (Interview) tell teachers to differentiate their practices for their students, yet “when the administrators or whoever’s in charge then is there teaching what’s going on, they’re not differentiating… They’re not always providing you information, knowledge in the context of where you’re actually going to use this” (Interview). Ed described his posted photograph, which supported this position, as relating to professional learning in that it should be clearly relevant. He stated that teachers often ask, “When are we ever going to use this in our teaching?” (Interview). Concerning mandated professional learning, Ed believed that even when

expectations were clear, mathematics teachers struggled with implementing the strategies into their classrooms.

Helen asserted that, although the mandated sessions may promote "little, nice cutesy things to do," the overall goals did not match her professional learning needs to gain immediate content knowledge. "It's not what I'm needing to do to get across to these kids, the information, and at that moment" (Interview). Lucy provided a different criticism about mandated professional learning. She was required to attend two professional learning sessions in a nearby metropolitan city in which she would be trained on how to teach a new senior-level course. She explained that the first session took place at the beginning of the summer, and the second, follow-up session took place at the beginning of the following school year. Lucy then pointed out how the second session repeated the same information as the first session. "I had to go back and listen to the people that I had been in training with teach me the same thing… And the leaders were in my [first] training!" She assumed that her mandated attendance was required by her school system. Would she have gone to the second session had she been given the choice? "I probably would have gone until I realized that I didn't need to be there again because it was the same stuff" (Interview).

Collectively, the participants indicated that if the focus of the professional learning session did not relate their content or instructional practices, they dismissed the experience and did not attempt to implement the promoted learning goal. If the mandated professional learning session contained applications of mathematics, the participants were more willing to implement the proposed strategies. For example, at the same state-mandated session, Lucy described that the information was pertinent to the new course

she would be expected to teach the following year. She indicated that the facilitators of the session "basically just gave us the teacher binder and went through it with us. They wanted to give us a feel for how the class should run. We tried to implement these ideas in our classroom this year, FAIL" (Blog Entry). Lucy later explained during a follow-up interview that by "FAIL" she meant that the strategies were not successful when she tried to implement them. During the interview, she reflected upon the experience, and explained that she specifically tried to use "their guides to how to run" the classroom more than the mathematical content that was presented. She took away some of the things that "as far as the content goes that I'd never seen before" (Interview), but she disregarded the content with which she was familiar. Instead, she attempted to implement the facilitators' suggestions for classroom management, collaborative activities, open-note assessments, and homework assignments. Although she tried to implement these strategies, she did not believe the strategies were effective for her students "just because these kids have never experienced anything like that, and they are just thrown into this their last year of high school" (Interview). She said that some of the ideas had the potential to be effective, but she admitted, "It's not utopia [Lucy laughs] in the classroom. We have kids that miss all the time… I don't know if it is created for the kids we have in there."

Lucy's example highlights the fact that although the content of the professional learning was related to the content she taught, the classroom management techniques, a professional goal *she* desired, was not applicable to her students. The participants' definitions and perceptions of relevance became a "make it or break it" moment in the participants' professional learning process. As I explored the participants' ideas of

professional learning relevance, I discovered that they adapted their definitions of relevance to their self-defined professional learning goals. For example, Lucy pointed out in a blog entry that the “worst learning experiences are the meetings that all the teachers attend” as they seem to only meet the needs of the “lowest common denominator” and not her individual needs. Each of the participants maintained different educational needs that depended on how each person defined his or her goals, stage of life, and career level. Therefore, their idea of “relevance” was relative to the degree that the mandated professional learning opportunity actually met their personal needs. When the session missed the mark, the participants noted that they would rather be in their classroom planning.

Mary's idea of relevance is narrowly defined by her subject area and context. Therefore, she preferred to specifically collaborate with people within her department who also teach her “level” (Interview) of students. Additionally, she emphasized that she wanted to only collaborate with teachers from Site 1 because she believed that other school contexts were different than Site 1’s context, and therefore, teachers at other schools used practices that were irrelevant to what she could accomplish at her school. Mary felt that the context for learning provided both advantages and constraints within which she had to learn. Schools that had different resources, low performing students, or varying school schedules were not applicable to her environment. “I feel like we get more out of collaborating [among ourselves] than… collaborating with others” (Interview). Therefore, she deemed the professional learning session irrelevant.

Ed was a little more broad with how he defined educational relevance. He explained that he was interested in learning a variety of things. He was mostly interested

in either ideas he could take back and use in class because “it might be something worthwhile for the kids” (Interview), or the topic may be on something he is just interested in learning. “And it can be either. I don’t have to always go learn something for my kids” (Interview). Because Ed maintained a wide-ranging definition of relevance, he was likely to be engaged and therefore implement professional learning strategies that were presented to him.

Likewise, Ellen was also interested in learning about a variety of topics. However, she asserted that the relevance of the professional learning was truly established by the needs of the learner “because people have different needs at different stages of their professional career” (Document of Digital Images). Ellen lamented that in the early stages of her career, she recognized that she had a problem with classroom management. “I’m still not… Right now, I would not bother taking a workshop on discipline because if I haven’t figured it out in this time period, I’m not going to do it” (Interview). She stated that in her current career stage, she was more interested in having her students make connections, use technology, and do something innovative and creative. Ellen believed that teachers have different needs, ranging from classroom management, teaching styles, learning new content, or using technology, and for that reason, professional learning should be differentiated by learners’ career stages. “The grade level you teach, or the subject that you’re teaching, or what technology you have in the classroom. I think the trajectory of the profession is an entirely different stance on it” (Interview). She noted that her opinion about professional learning relevance had evolved out of her teaching experiences.

> I started thinking that at one point in time I felt this way, but I’ve changed, and I realized what has made me change is experience in the classroom.

> So it dawned on me, perhaps you need different professional [learning] as you progress through your career as well. (Interview)

Teachers who did not have the option of establishing their own goals were far more skeptical of the relevance of professional learning experience. Ed suggested that teachers' perception of justification or applicability of the learning experience was critical. When excluded from the goal-setting process, educators "instantly rile up, going, 'okay, convince me this is worthwhile'" (Interview). As an educator, facilitator, and department chair, he recognized the importance of teachers being open in the learning process. For example, Mary expressed anger towards the process through her account of a negative professional learning experience. When she was given an iRespond system that she felt she would not use, she begged the question, "Why didn't they ask *me* if I wanted this iRespond? Why didn't he ask me if I thought it was going to be useful?" (Interview). Those who set her goals left her out completely. Without the justification of the purpose of the goal, Mary developed her own negative rationalization for the iRespond initiative. "I feel like that the only reason why they spent *all* this money on *all* this technology and *all* these trainings was so that Big Brother could look over our shoulder" and get their students' grades. She continued and pointed out that if they wanted to know her grades, they could have "just asked" (Interview).

Job Satisfaction and Professional Learning Goals

The participants' long- and short-term goals were also a point of discussion during the interviews and follow-up interviews. The participants' investment within their learning community mirrored their motivation to participate in professional learning and shed light on their enjoyment of teaching. For example, Betty wanted to retire within three years because she was tired of having to adapt to a curriculum which she felt was

constantly changing. She loved the students but resented the amount of time she put into her planning. Within a year after the study, she had retired mid-year, only to return sporadically as a substitute teacher and volunteer. How were her long-term career goals related to her professional learning processes? Betty did not independently pursue professional learning opportunities. Among the formal professional learning opportunities of which she participated, she preferred those that helped her to either plan her curriculum or create materials for her classes using technology. Her need for organization and structure, which she sought to learn about through professional learning opportunities, ultimately drove her away from the classroom as she grew tired of working and planning for "14 hours a day" (Interview). Similarly, Lucy also indicated that she considering leaving Site 1, but she wanted to continue to teach in a different setting. Specifically, Lucy pointed out that she would rather take a substantial pay-cut to work part-time in a private school that adopted traditional textbooks and embraced a curriculum similar to what she had experienced as a high school student. Lucy's long-term goal of possibly changing schools was related to her professional learning goals as she sought contexts (either professional or in regards to professional learning) in which she could find, locate, and learn how to use tools to help her manage classroom materials and strengthen her organizational skills. Mary, although claiming she wanted to continue teaching for at least 10 more years, indicated during a follow-up meeting that she disliked certain aspects of her job. She enjoyed the paperwork, organization, and curriculum development aspects, yet she professed that she did not enjoy teaching. Mary indicated that she would rather have a desk job organizing materials for a large company. She admitted that she "hates" (Follow-Up Interview) working one-on-one with students, and

that the only reason she still teaches is because her family needs the income. Within professional learning contexts, Mary was also resistant to working with teachers from other schools.

At Site 2, staff morale was more positive, with the exception of Helen. She indicated that she often worked late and in isolation to the detriment of her health. Helen enjoyed teaching, but she expressed that she had to continually prove herself with the administration and the parents of her students each year. As discussed in her PLP, Helen had several conflicts with her administrators throughout the year. During the study, she expressed her need to defend herself and her instructional practices to her administrators when her freshmen students' parents complained. In her eyes, her administrators assumed she was guilty of whatever action that her students' parents had suggested. Since the time of the study, her working conditions continued to deteriorate. In a follow-up interview, Helen stated that she was teaching a new "low-level" course for seniors that she had not taught before in addition to a mathematics course online. She pointed out that she was the only one teaching either of the courses; therefore, she was teaching in isolation more than ever before. Helen revealed that the stress of her job was making her physically sick at work and at home, and so she decided to pursue the option of transferring to a different school in within her school district in order to have a fresh start. Ultimately, Helen's negative experiences of interacting with others influenced both her professional learning experiences and her motivation to continue to teach at Site 2. As detailed within her PLP, Helen worked in isolation because she believed that her common subject area peer did not want to collaborate or plan the course with her. Therefore, she discussed

professionally learning in isolation. Likewise, her negative interactions with her administration frustrated her and made her want to transfer to a different school.

Laura's job satisfaction waxed and waned throughout the year. Per her interview, she attested that she was more motivated at the beginning of the year, and frazzled and exhausted by the end of the year. She loved teaching, even though she grew increasingly concerned about her students' attitudes and persistence engaging in problem-solving. Regardless, she still wanted to teach at Site 2 until she retired. Ellen and Ed had enough teaching experience to retire; both implied during their interview that they still wanted to continue to teach. Specifically, Ed wanted to continue to teach until "it stops being fun" (Interview). Ellen wanted to teach long enough to see the effects of the new curriculum on how students think about mathematics. She wanted to see whether her students would be better problem solvers. Ellen indicated that loved she teaching, and she encouraged her "best" (Interview) students to also teach mathematics. However, during a follow-up interview Ellen revealed that she may have to retire sooner than she expected because she had begun caring for her ill mother. If she chose to retire early, she indicated that Ed would most likely retire with her. In total, participants at Site 1 preferred to retire or teach elsewhere, but continued to teach in spite of their desire to leave the profession. At Site 2, all the teachers enjoyed teaching mathematics, although Helen wanted to transfer to a different school. Ed and Ellen, although they loved their profession, revealed that they may retire for family-related issues. Comparatively, Ed and Ellen both enjoyed teaching and professional learning. They embraced both experiences and expressed contentment with their professions even though they could retire. Laura, who is the only participant

who wanted to teach at her school, planned to continue teaching for at least five more years.

Participants' Perspectives of Expert Mathematics Teachers

The participants also discussed their image of an ideal or expert mathematics teacher. I provided several opportunities for the participants to describe an expert mathematics teacher because I was interested in what characteristics they admired in their perspective of an ideal mathematics teacher. Additionally, I was also curious to explore whether the participants believed they were or could be an expert mathematics teacher. The participants' self-reflective perception of whether they met their own expectations of an expert mathematics teacher shed light on not only who they wanted to be, but also whether they thought this goal was attainable. All of the teachers who completed the initial survey also answered the free-response item asking them to complete this sentence: "The ideal mathematics teacher must ___." Teacher responses ranged from understanding content knowledge to being flexible in order to meet students' needs. Betty wrote that ideal teachers should "know the subject well, and be able in explain simple terms. Must be structured" (Survey Response). During the interview, she asserted that expert mathematics teachers should be able to make up "good questions," "know the content," and "keep the kids engaged." She did not believe herself to be an expert mathematics teacher because she had not taught any upper level mathematics courses. For Betty, the lack of upper-level content knowledge was holding her back from being an expert mathematics teacher. Mary believed that an expert teacher must "know her subject" (Survey Response), and during the interview, she elaborated on an expert teacher's qualities to describe someone who is very knowledgeable of the curriculum, and who

understands that “math is a big puzzle.” Mary asserted that this teacher should also understand how “all the pieces fit together” (Interview). Neither Mary nor Betty believed they were expert mathematics teachers because they did not believe they fully understood the entire curriculum that followed their course.

Helen also believed that teachers should “have knowledge of [their] content,” “the freedom to take risks with students,” and should also be “valued by administration and community” (Survey Response). However, she asserted that she was an expert mathematics teacher. Helen explained that she met all of her standards of an expert mathematics teacher, including being “observant” (Interview) and “flexible” (Interview) in order to determine and address student learning gaps. “You’ve got to be a well-rounded person.” Helen was the only participant who definitively believed that she was an expert mathematics teacher. Lucy, wrote that expert mathematics teachers “prepare students to be able to think logically and use mathematics for their future” (Survey). During the interview, Lucy pointed out that these teachers are “collaborative in a professional, meaningful, and constructive way… She must know everything about mathematics and be able to teach upper level courses, while being able to communicate what she knows to her students.” Although Lucy did not believe herself to be an expert mathematics teacher, Helen and Lucy’s descriptions moved beyond content knowledge and engaging students to also include being well-rounded, flexible, and collaborative. Lucy’s inclusion of “collaborative” (Interview) as part of her definition of an expert teacher extended beyond what teachers know about mathematics to include how they interact with others within the workplace. Laura believed expert teachers should be able to “find a balance of delivery verses discovery that provides the best learning

opportunities for student given the time constraints" (Survey Response). She also believed that expert mathematics teachers upheld high expectations for her students while also "sticking to their standard" (Interview). She also wrote that exemplary teachers at her school maintained "communication [that was] always genuine and two-way" (PLJ entry). Noting the difficulty of meeting her own standards for exemplary teaching, she asserted that these teachers probably do not "get much sleep."

Ed felt that expert teachers should be professionally emulated. He wrote that these teachers must "awaken the curiosity in all students to explore mathematics, with the knowledge of content and pedagogy to 'guide' their travels" (Survey Response). As he discussed his photograph of a bulletin board filled with mathematician illustrations, he explained, "It was the closest I could get to... professional learning should rely on the experience and expertise of others."

Figure 40. Ed's Photograph of a Bulletin Board of Mathematicians

He went on to assert that he did not think that expert mathematics had to know all the answers, but that mathematics teachers should also be mathematician who "love doing problem solving." Additionally, he went on during the interview to describe these

teachers as humble, capable of adapting to challenges in the classroom, and willing to share their struggles and triumphs with their colleagues. Ed's photographs of expert mathematics teachers also paralleled his interest in wanting to learn from expert mathematics teachers. As previously stated, Ed and Ellen attended conferences in order to learn from other practicing teachers. Ellen wrote on her survey that mathematics teachers must "obey Polya's Ten Commandments for teaching mathematics (with my comments added on back)." Recall that Ellen amended Poyla's Commandments to be more student-centered in that teachers should know their content—and their students. During the interview, she indicated that expert mathematics teachers should be "flexible" and "able to change to meet the needs of the kids, wherever they are." She also proposed that expert mathematics teachers should be able to differentiate, providing additional assignments or scaffolding to help students be successful.

Ed and Ellen's definitions of expert mathematics teachers moved beyond having to know the entire curriculum and underscored the interpersonal relationships that teachers should form with their colleagues and their students. However, Betty and Mary indicated that they did not consider themselves as expert mathematics teachers because they did not know the entire mathematics curriculum. Ed and Ellen, however both indicated that they were striving to be expert mathematics teachers but had not reached that goal. To both Ed and Ellen, reaching such a goal meant having perfect lessons and engaging all of their students each day of the school year. Because they both admitted that they usually had some in which they could improve, attaining expert teacher status may be an unreachable goal that they may not attain.

Table 6
Summary of Participants' Goals and Perspectives of Expert Mathematics Teachers

Goals	Betty	Mary	Helen	Lucy	Laura	Ed	Ellen
Short term	• Retire within five years	• Develop a foundation for 9th grade mathematics	• Build calculus knowledge	• Teach lower-level 9th grade students	• Refine teaching practices	• In terms of learning, "The sky's the limit"	• Learn methods and content associated with curriculum reform
Long term		• Teach 10th and 11th grade mathematics	• Survive the school year • Retire and tutor privately	• Teach 11th grade students, and possibly leave Site 1	• Earn additional Advanced Placement endorsements • Learn how motivate her students	• No set goals. Participates in activities until he wants to try something new	• To see the entire flow of the curriculum to see if it "works" in making the students better problem solvers
Expert teacher characteristics	• Knows all the curriculum • Good problem creator • Engaging • Teaches higher-level classes	• Knows all the curriculum • Helps students make mathematical connections • Sees the "big picture" of mathematics Evolves and adapts	• Well-rounded content knowledge • Observant • Flexible and differentiates to meet all students' needs • Compassionate	• Knows all the content • Collaborates • Teaches upper level mathematics courses • Shares with other teachers • Flexible and adaptive • Excellent communicator • Forever learners	• Maintains high expectations for her students • Teaches rigorous curriculum • Engages and motivates student • Makes learning enjoyable	• May not know all the curriculum • Model a love of learning • Good problem-solvers • Humble • Share mistakes with other teachers • Adapts difficulties into teachable moments	• Flexible to meet all students' needs • Creative • Well-rounded content knowledge • Understands multiple processes of problem-solving • Discerning judgment in facilitating classroom discourse
Does the participant believe he or she is an expert mathematics teacher? Why or why not?	No. She cannot teach higher-level classes.	No. She was still learning algebra, and had difficulty seeing where the curriculum was going.	Yes. She cares for her students. She could help them without breaking their spirit. She also knows her content.	No. "It makes me feel like I have to know everything."	Partially. She struggles to engage and motivate her students.	Sometimes, but he feels he feels he still has good and bad days. He believes he can improve his practice.	Sometimes. She does not have good teaching days every day.

Contexts for Professional Learning

Szatajn, Campbell, and Yoon (2011) indicate that professional learning structures provide a contextual backdrop for when and where teachers are exposed to or engage in professional learning. Within the theme of contexts for professional learning, the categories of professional learning structures and locations for professional learning will be discussed. How the participants learned, with whom the participants collaborated, and the content of professional learning is discussed within the other themes detailed in this chapter.

Professional Learning Structures

When the participants engaged in the learning process, they described structures that created a place and time for learning. The participants' descriptions of the structures varied with respect to the context of the professional learning. Regardless of whether the professional learning was mandated, teachers were learning within their schools, their school districts, and even at state and local conferences. The participants expressed preferences as to when and where they wanted to learn. Based on the free-response surveys, I suspected that "time" would be a category or theme that emerged from my data analysis. However, I was surprised by the finding that *when* teachers learn was just as personalized as their learning goals.

Contexts within the school district. Teachers learned within a variety of contexts. When involved in professional learning (PL) experiences in which they took part in developing the goals, the teachers usually found a way to learn at their school, either within their classroom or workroom where they had lunch. When teachers were

mandated to participate in professional learning, they attended sessions either within their school or went to a different school within their school district.

Online learning and graduate school. The participants provided mixed reviews about online learning. Helen and Laura, in particular, pointed out that they voluntarily enrolled in online courses. For Helen, she enjoyed the flexibility of being able to set her own goal and work at her own pace. “I’m so busy right now. I can do it at my own pace” (Interview). During the interview, Laura spoke about online learning as she described her photograph of the website for online registration. She explained that she took the photograph because it represented the “self-initiated” professional learning in which teachers must obtain professional learning “outside of the class” (Interview). Laura stated that although she had to take courses to renew her Advanced Placement certification, she could choose which classes she wanted to take.

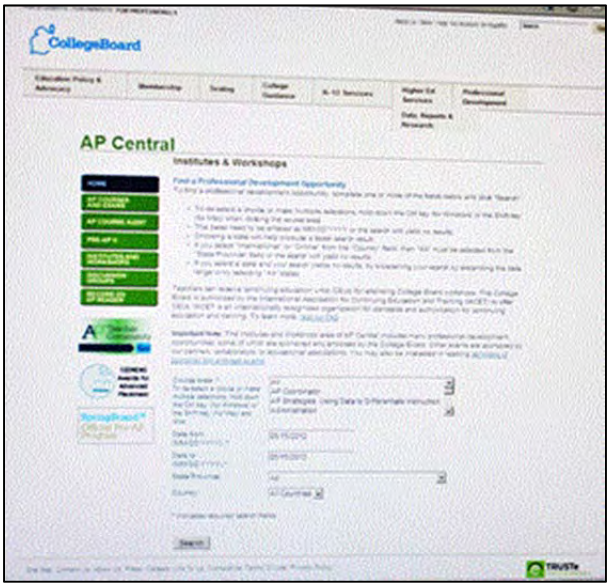

Figure 41. Laura’s Photograph of an Online Registration Website for Professional Learning

Laura liked online learning because she could take it during the summer when she could focus completely on the content matter without the distractions and stresses that emerge throughout the school year. In contrast, Ellen stated during the interview that she was “not wild about” online learning because the content was shallow. She asserted that she did not receive the advanced support she needed as she tackled her own learning goals. “Personally, I don’t care for online or less-interactive PD, but I want that interaction to be with people who are taking the PD seriously (as opposed to those who are being forced to take it)” (Ellen’s Document with Images and Explanations).

For Lucy, online learning was part of a graduate school program. During the time of the study, she was enrolled in an Educational Specialist program in Instructional Technology. Her graduate classes were presented in hybrid form in which some of her classes took place on the school’s campus and other courses were offered online. Lucy was the only participant who discussed taking online classes within a graduate program. Other participants indicated they attended graduate classes on the school’s campus. For example, Ed and Ellen enrolled in a Specialist program in Mathematics Education together prior to the study. Although the two ultimately abandoned the program to pursue other types of professional learning, their willingness to seek out and pay for professional learning opportunities outside of their school districts is an indicator of their desire to learn. Ellen explained during the interview that “We just felt that there was something missing out there.” They discovered several conferences outside their state for which, as Ellen explained, the facilitators were “excellent and successful high school teachers [who]… were in it. They were being successful in what they were doing. And we could get a lot of information from that that was hands on right now.” Ellen and Ed determined

that their college classes were not meeting their educational needs. Instead of staying in the program anyway or quitting the program to wait for another learning opportunity to be given to them, they researched their options, funded their own participation, and attended the conferences of their choosing. In contrast, other teachers in the study preferred to learn only within the confines of their particular school.

Locations for Professional Learning

Proximity of learning experiences with relationship to one's school or classroom indicated the extent to which teachers were willing to work with other teachers within or outside their school or even take the risk to learn outside of their school. For example, both Mary and Betty enjoyed working with their colleagues during their lunch periods. Betty pointed out that one of her favorite learning experiences took place "during lunch when a teacher suggested the best way to teach transformations" (Blog Entry). During the interview, she explained that she took a photograph of her peers at lunch because "Lunch is the time that generally… interacting… learning from each other." Mary also enjoyed working with her colleagues at Site 1. "I think that the most meaningful professional learning to me occurs informally when I make ten minutes before or after school, or during my lunch to meet with a colleague on a regular basis" (Blog Entry). Mary also asserted that "I feel like we get more out of collaborating with [each other] than with… others" (Interview).

Mary wanted these opportunities to be less happenstance and more intentional. As expressed within her case study, Mary felt that her administrators should provide and mandate teachers to participate in common planning. "It would be great to have common planning with mandated attendance at least once or twice per week" (Blog Entry). She

assumed that a mandated common planning period would feel as if they had professional learning every day. However, the teachers at Site 2 revealed that even though they had access to a common planning period, their peers' willingness to genuinely collaborate was inconsistent, slowed the learning process, or fostered climates for contrived congeniality.

> What I've seen overall… even when you have big groups… just one or two people who are like "Here are the things that I've done." … But now, the way our administration comes around once a month… During your planning, they want to observe during your planning. They get to see a little bit more. (Helen's Interview)

> I've worked in horz teams before where we have developed a common plan, unit assessment, etc. and have agreed on implementing it. ["[H]orz teams" is the abbreviated form of horizontal teams, or teams of teachers who teach the same content. For example, a horizontal team of teachers who all teach Geometry may get together and plan the course for the year.] Only to later find out that a particular teacher went of [*sic*] on their own and didn't follow the plan. This was saying that our common goal was not their goal… I've personally witnessed autonomous teachers at our school work collaboratively in a horz team only to criticize and belittle them outside of their group. It's a personality and ego thing. (Laura's PLJ entry)

Because Sites 1 and Sites 2 were both within the same school district, all of the teachers in the study were subject to the same district mandated in-service days on which they were required to attend professional learning sessions at their school or other schools in the district. However, even with this commonality, participants at Site 2 indicated that they were more willing to voluntarily travel outside of their school to pursue learning. As discussed in the previous Human Resources summary, teachers at Site 2 were more likely to embrace collaboration with peers outside of their school.

Helen explained that "most of the time when I don't [find the resources at Site 2], I get on the phone" (Interview).

Figure 42. Helen's Photograph of Her Cell Phone

Helen's cell phone use allowed her to venture out of her school for help without actually having to leave her classroom. In this way, she used technology (her cell phone) to gather advice or resources from her peers. Ed and Ellen's participation in numerous off-site professional learning activities was unique. The married couple taught the same subjects at the same school for many years together, and Ed and Ellen may have been more willing to explore learning opportunities outside of their school district because they chose to learn with each other.

Figure 43. Ellen's Images of Learning Conference Advertisements

Ellen wrote in her document containing her images that:

> National PD offers much variety and is usually of excellent quality… PD should teach us something, renew our spirit and help make connections for us. Those connections could create a learning community—as part of a vertical alignment, a horizontal alignment or just a philosophical alignment. However, those connections could also be personal

> revelations—new ways to reach students or bridge a difficult topic to previous knowledge.

Together, Ed and Ellen coached their Math Team and benefited from the networking and learning that took place at various tournament sites throughout their state. They also both held leadership positions in the state-affiliated mathematics teacher association for which they facilitated sessions, collaborated with teachers of different levels and areas of expertise, and developed and coordinated state-funded professional learning sessions for teachers all over the state. As their mathematical teaching experience helped them evolve into educational leaders, a variety of learning opportunities at different locations became invaluable. They attempted to take graduate classes, but when they felt that the goals of the program were not meeting their learning goals, they abandoned the program in search of something more suitable. "And we just felt that there was something missing out there. So we started looking, and realized that Exeter had this wonderful technology conference. North Carolina School of Science and Math had this beautiful calculus conference" (Interview). Ellen explained why she felt it was necessary to geographically broaden her search for professional learning.

> A lot of the courses tended to say the same thing. When you started looking at what teachers were doing in their real classroom, you were getting a glimpse of what innovations, what innovative high school teachers were able to do, and perhaps it wasn't necessarily in [her state], but in different areas, what could happen… And I definitely think I grew a lot. Um, started changing questions I would ask, my questioning techniques. I think… I'm not sure my teaching techniques changed a lot, but the type of questions I would ask, did. I went deeper. I didn't think about going deeper until then. I didn't think I could… It isn't until you hear other teachers explain what they're teaching that you realize my kids can do that. (Interview)

For Ellen and Ed, learning from other teachers was important. Ed felt that teachers should "emulate" expert teachers (Interview). Ellen professed that unlike college

professors, teacher-facilitators understood her challenges because they faced the same struggles she faced each day. Through the college classes, Ed and Ellen were only "seeing a snapshot… of what was happening here [within the contexts of mathematics classrooms within her geographical region]" (Interview). When they traveled to conferences outside of their state, the fresh perspectives and intensive support helped Ellen gain confidence in what she and her students could accomplish. "It's a proximity issue, I think, as much as anything. And I wanted to see something bigger, what else was out there. And I did, and it was good" (Interview). Possibly, Ed and Ellen gave each other confidence to pursue these opportunities because they were learning together. Summer trips to extended conferences provided Ed and Ellen a chance to learn from those they viewed as expert mathematics teachers. They also frequently traveled to the annual National Council of Teachers of Mathematics conferences together. During a follow-up meeting, Ed explained that these trips felt more like vacations because that was the only time of their year when they were able to catch up with "old friends" (Follow-Up Interview), who shared their interests in learning about teaching mathematics.

Preferred Contexts for Professional Learning

During each interview, I asked probing questions about the participants' previous positive and negative learning experiences. Collectively, the participants' accounts provided contexts in which they elaborated about aspects of the professional learning process that they preferred and disliked.

Positive learning experiences. The positive learning experiences that the participants discussed involved informal scenarios during which they collaborated with peers to problem-solve, conduct peer observations, plan, or learn how to teach a new

course. For example, Betty enjoyed collaborating with her peers at lunch in order to learn how to use a software program. “My best learning experience was during lunch when a teacher suggested the best way to teach transformations. She suggested using TI InterActive! and my students have enjoyed the process ever since” (Blog Entry). TI InterActive! (Texas Instruments Incorporated, 2012) is a mathematical software program that allows users to create mathematical graphs, tables, and charts that they can import into word processing documents. All the participants favored experiences in which they informally worked with their peers. Mary wanted to create professional dialogues, observe her peers and be observed by her peers through the peer coaching program. She noted that “simply opening up our classrooms to one another informally. When I get to watch a fellow colleague in the classroom, I get so much out of the observation” (Blog Entry). Lucy also valued the opinions and perspectives of her colleagues as she described her floating experience to be one of her favorite learning experiences. She stated that although she floated, she observed mathematics teachers throughout the day and, according to her blog entry, she “stole” (Blog Entry) their ideas pertaining to classroom management and organization. “I saw other teachers styles of setup, how they ran things, and I could ask them for suggestions” (Blog Entry).

Although Helen professed that she primarily worked by herself as she planned her lessons, she noted that her favorite professional learning experience was working with another colleague to create a discovery task for her students that she later implemented. As discussed in the Professional Learning Profile, Helen enjoyed working with a colleague to make a spaghetti string task in which students would later construct the parent graphs of trigonometric functions. “I look forward to introducing this activity as a

visual connection between the sine, cosine, and tangent values and the unit circle each time I teach the unit" (Blog Entry).

Laura recalled that she enjoyed going to a district-provided session in which a "really good" (Interview) teacher from another high school presented several instructional tips and strategies, which she later implemented into her instructional practices. Not surprisingly, Ed and Ellen both preferred to learn with each other. Ed discussed how they would attend conferences all over the state and nation to go "visit friends" (Follow-Up Interview). Ellen described that her "perfect professional [learning] day" (Interview) was not one that was an officially mandated professional learning, but instead was informally learning to use a graphing calculator with Ed. She also wanted to attend conferences with Ed because she enjoyed learning from the "movers and shakers" (Interview) within the field of mathematics education.

What do most of these experiences have in common? Each of the participants sought out other peers with whom they could contextualize, ask questions, and problem-solve. Although the participants were learning different things during these experiences, all of participants expressed a desire to work with teachers whom they either admired as "respected peers" (Helen's Blog Entry), "movers and shakers" (Ellen's Interview), teachers to "emulate" (Ed's Interview), or other colleagues who have similar content knowledge. Other professionals, such as administrators, department chairs, mathematics coaches, or professors were not a part of these positive learning experiences. Ed, who was both a teacher and a teacher leader, was involved with coordinating and facilitating professional learning opportunities for other teachers. However, Helen, Laura, and Ellen spoke differently as to how they used Ed as a resource for learning. For example, Helen

wanted to observe Ed when she tried to learn calculus content. “I tried to sit in on Ed’s but it goes so fast” (Interview). Helen would also call Ed on the phone if she had a mathematical question. Laura, however, viewed Ed as the encourager—not a learning partner or leader—acknowledging him as “trying to keep everybody motivated” (Interview) even through curriculum reforms. Ellen was the only participant that noted how much she enjoyed learning *with* Ed and indicated that her favorite professional learning experienced was when they learned how to use calculators together. Given that Ed and Ellen were married, it seems unlikely she sought him out as a collaborator because she valued his expertise as department chair, and that their marital status provided a unique context in which they learned together. Therefore, all of the participants valued and enjoyed working with other teachers; none of the participants indicated that they desired to professionally learn with or from administrators, department chairs, mathematics coaches, or college professors.

Negative learning experiences. Among all of the participants’ negative professional learning experiences, their accounts maintained one consistent commonality—mandatory professional learning experiences. Each participant described being required to attend in-services, workshops, or faculty meetings in which the facilitators presented information that they would “never use” (Betty’s Interview) or only spoke to the “lowest common denominator” (Lucy’s Blog Entry). For example, Helen pointed out that her school provided lunch-and-learns, and attending teachers listened to a facilitator present while the teachers ate their lunch. However, Helen noted, the teachers were not really learning anything. “You’re just eating lunch, and you’re listening to this

person present. And nobody goes back and looks at the stuff because you don't have time anyway" (Interview).

Betty resented having to attend one-hour demonstrations in which she merely watched instructors use technology that she "was never going to use" (Interview). Both Helen and Laura also spoke of attending sessions about technology. Helen indicated that she did not want to learn about technology that she did not have access to within her school. "Don't show it to me now while I don't have one" (Interview). Laura also described a session wherein the presenter illustrated how to use a software program that only statistics and calculus teachers could use, but that she would not use. She felt that everyone was required to go to this session because her county wanted to justify buying the software for all of the district's mathematics teachers.

In criticizing the school district's required professional learning sessions, Ed and Ellen both expressed that far too many sessions were not applicable to contexts of teaching mathematics. Both participants maintained that these sessions were too broad to fit the needs of mathematics teachers, and recalled that after the facilitator was asked about the applicability of the strategy to a mathematics setting, the English teacher facilitator could not articulate how to implement the strategy within a mathematical context. As Ed noted, they wanted all teachers to implement these strategies, but the facilitators did not provide the "information, knowledge in the context" (Interview) of where and how teachers were going to use the strategies.

Mary was most frustrated by an experience that occurred during preplanning when all of the faculty members attended a session in her school's auditorium to listen to a motivational speaker. Mary found these experiences had "nothing to do" (Interview)

with addressing her professional needs, and that the time could have been better spent by planning for the upcoming school year. Although Lucy's experience did relate to her content, she was frustrated because she was presented repetitive information. She explained that her state department of education required her to attend a workshop on the new curriculum she was teaching for the upcoming school year. She had already attended this week-long workshop during the first week of the previous summer vacation. During fall semester of the subsequent school year, she was required to attend another session. She described the second workshop's content as "the same" (Interview) as the content covered the previous summer, and that "the leaders were in my [previous] training!"

Mandated professional learning. Across all of these examples, the participants' worst experiences reported were when they were forced to attend professional learning sessions that did not meet their learning needs. They felt that their school district was disconnected from their department and expected them to attend generalized faculty meetings that, as Lucy pointed out, only aimed at teaching to the "lowest common denominator" (Interview). Ironically, all participants reluctantly admitted that they believed that professional learning should be required.

Most of the participants pointed out that teachers should model a love of learning for their students by pursuing professional learning opportunities; yet, they did not think that all teachers would voluntarily attend and participate in professional learning. Betty, for instance, believed that all teachers had "something that they need to learn to better themselves" (Blog Entry). Both Betty and Lucy expressed that teachers needed help from others to set goals. Betty, in particular, felt that learning goals should be defined between the teacher and a mentor by examining "what areas you would like to improve on and

what others think that you need improve on in a combination" (Interview). Mary's views differed from Betty's regarding goal setting as she asserted that teachers "do better coming up with their own goals and areas of concentration… rather than having it micromanaged by administration" (Blog Entry). However, Mary still approved of required professional learning because she felt that teachers should adapt and change through collaborative, yet still-required, professional learning.

> The clock, it's always changing, but I don't think that how it's presented should be required… I think it should be more local and more collaborative rather than somebody standing up there and lecturing. (Interview)

Furthermore, Mary valued collaborative planning to such a degree that she wanted "mandated attendance at least once or twice per week" (Interview) among common subject teaching teams. She rationalized this through her own experiences in which even those who complained about having to meet with the group later confessed that the collaboration sessions were helpful. Helen argued that although the desire for professional learning should be a "natural" (Interview) characteristic of teachers, many teachers just "don't feel that way" (Interview). She pointed out that even if teachers are required to attend professional learning sessions, they are really "just going through the motions" (Interview).

Laura referred to her previous job as an engineer to rationalize why professional learning should be required in order to renew a professional certification. As with most of the participants, Laura suggested during the interview that the expectation to learn and model learning for students was important. She indicated that requiring teachers to pursue their own learning underscored the "the importance of always learning or always being

willing to learn… If I'm asking my students to learn, then how can I not hold myself accountable for learning?"

> Even as an engineer we have, I had to renew my license you know, every two years. And, part of that was to, um, you know, I guess attend courses in whatever that, where you got—I don't know if it was, I don't know if it was CEUPL, whatever was whatever letter we had to get, you know, (clears throat). Um. I think there's always something new you can learn. I don't think you ever stop learning. Um. So. Just like with my calculus class, even though I'm going to teach it again, I feel like there's always something *better* I can do. (Interview)

Ed's position as a department chair informed his perspective as an educational learner. During the interview he cautioned that professional learning imposed on teachers "from the top" should be selectively thought out and limited so that "it's not a burden, and if they can be at least semi-effective" (Interview). He recognized that teachers must buy into the process, yet they are not "innately motivated to learn" (Interview). He indicated that providing external stimuli, such as lunches, effectively motivated teachers to attend sessions on topics "that all teachers need to be exposed to" (Interview), such as technology issues or a new email system. He admitted that, as a teacher leader, he understood that some teachers will not always apply what they had been exposed to during a professional learning opportunity.

> They need to be exposed to it [because]… they're not going to go out and search it on their own… You've got to force them to go through the motions… If you don't mandate that they go to things like that, they won't, they won't ever get started… But if you go, and you get one or two people who ordinarily do nothing, and suddenly they do something, that's a success. (Interview)

Although Ellen shared some of the participants' views on required professional learning, she was the only participant who pointed out that teachers should want to learn in order to "keep up with the new trends for new education systems" (Interview). She

suggested that teachers should learn about and respond to curriculum changes much like doctors should be abreast of updated resources and medical equipment. “For information’s sake alone, teachers need to be required to have updates on what is happening in their curriculum” (Interview). She also believed that teachers should be “good examples for our students” (Interview) and model a positive attitude toward learning.

> If we say, “I don’t want to attend professional [learning],” we’re saying basically, I don’t want to learn any more. That’s not what we need to be doing as educators. As educators, we need to be saying, “I want to suck up every piece of knowledge I can find in the world.” Or our kids won’t have the same attitude. (Interview)

Therefore, although all participants primarily criticized professional learning sessions at which required the teachers’ attendance, they all agreed that requiring teachers to attend professional learning sessions was necessary. One expectation for teachers was to model positive attitudes toward learning for students; yet, they also believed that many teachers were not innately motivated to pursue professional learning by themselves. Mandated professional learning served as an important mechanism for updating teaching certificates, relaying mundane, but necessary general topics to an entire faculty, as well as keeping teachers up to date with changes in the curriculum and learning environments, both current and emerging.

Interactions with Authority Figures within Professional Learning Contexts

Across the all the participants’ stories of professional learning, various types of authority figures influenced elements of their professional learning process. Those in a position of authority had the power to make decisions about learning goals, their contexts for learning, funds for professional learning, or when they were to be required to attend

school- or district-provided professional learning sessions. Each participant differently described the power-struggle relationships that they believed existed within the context of professional learning. Some participants passively went along with what they were told to do. Others voiced their positions during the conflict or simply walked away from the experience altogether. For the participants, authority figures were state and school district leaders, school principals, mathematics department chairs, other mathematics teachers, parents, students or themselves. Typically, these educational stakeholders played a different role in either motivating or helping teachers to learn or becoming hindrances to the learning process altogether.

State and school district leaders. Most of the participants discussed how state and school district members established educators' learning goals and required their attendance at professional learning sessions; yet, the participants also maintained that these entities did not understand or attempt to meet their actual learning needs. Betty described an "awful" (Interview) experience in which she attended a professional learning session offered by her school district. The session presenters introduced various tasks related to the curriculum and asked the teachers to do the tasks during the sessions. "I don't think I needed to do it to understand what it meant… You had to go to it and learn it, and cascade it down. We did all that, and we still didn't know the content of what was going to be taught in the course" (Interview). She disliked the session because she felt that she was not going to teach using the promoted strategies, but yet she did not receive any clarification about the content that she was expected to teach. Mary felt that the school district should provide technical support for the technology tools that were disseminated among the faculty. During the interview, she explained that she received

support for technology that she was the least likely to actually use, such as her iRespond remote controls, but she was left to independently learn how to operate technological tools that she preferred.

Figure 44. Mary's Photograph of her iRespond Class Set of Remote Controls

Why did her school district spend money on technology that assists in assessing students' knowledge? Mary believed that her district, which she referred to as "Big Brother" (Interview), spent the technology funds to micromanage and monitor teachers through standardized tests. She argued, "If you wanna know [my students' grades], then just ask me." Therefore, Mary distrusted her school district because she believed that they only provided professional learning for teachers with the ulterior motive of monitoring student and teacher performances.

Laura described having both positive and negative professional learning experiences organized by her school district. However, she asserted that these experiences were not nearly as meaningful as the experiences she initiated by herself.

> I think the most meaningful professional learning occurs when initiated by the individual teacher in an informal and organic setting. While the county and the school organize professional learning opportunities for me throughout the year, the overall benefit pales in comparison to the learning events that I regularly and personally initiate. (Blog Entry)

Although the participants expressed sharp criticisms toward local- and state-mandated learning experiences, all the participants suggested that teachers who do not voluntarily seek out professional learning activities should be required to attend them anyway. Because they thought that teachers should model life-long learning for their students, they noted that reluctant teacher-learners should still be required to attend professional learning sessions. Betty explained her position during the interview. "Because I think that everybody has something that they need to learn to better themselves, but I think that needs to be defined… with a mentor." Helen also suggested that professional learning "should be a natural part that is unnecessary to have to be required. Unfortunately there are going to be people who don't feel that way" (Interview). Ellen also discussed that teachers needed professional learning for two reasons. First, teachers needed to grow as teachers and become better "facilitators of knowledge." Then, she pointed out:

> That's like reason two for professional [learning], and that is we need to know what is coming down upon us… I would like to think everything is, in the utopian world, it would be because we need to get better. In the real world, is, we need to become aware… Utopia versus reality. In reality things happen to us, and we need to know about them. And that's reason number two, but for many people, it's reason number one. (Interview)

All of the participants believed that teachers should model learning. The participants suggested that teachers who learn within isolated contexts were professionally obligated to attend to their own professional learning; if not voluntarily, then through authority-created mandates. For instance, Mary thought that common planning should be required in order to foster the collaboration among subject area teams. She asserted that "there was only so much they could learn from themselves" (Interview). Ironically, all the participants listed the mandated professional learning sessions as their

least favorite experiences. The participants expressed that these sessions were unrelated to their learning needs and failed to address their needs as mathematics teachers.

School administrators. The participants provided several examples of school principals exerting power, monitoring their progress, and in a few cases, providing educational advice. Along with state and local officials, school administrators applied or supplied professional learning to teachers. At Site 1, the participants expressed that their administration did not provide common planning, yet administrators could diagnose instructional problems by comparing the students' grade reports by teachers. For example, Mary justified administrators seeing and acting upon "red flags" (Interview) observed from the data.

> They wanna know… how can we help this person? If this person has thirty failing and this person has two, it's like "what is going on?" … I don't blame them for… checking stuff like that… because some teachers… they're not in the classroom. They are taking a sick day every day. There is a reason why their kids are struggling. (Interview)

Laura wrote that the administration "sets the tone for PD" and influences the "culture of a school" (PLJ entry). The participants implied that one of the administrations' primary function was to provide opportunities for collaboration. Teachers at both sites expressed an interest in working and collaborating with their peers. At Site 1, Mary said that she was jealous of teachers who had common planning, because it was "like they have professional [learning] every day!" (Interview).

At Site 2, teachers did have common planning, and given feedback from Helen, Laura, Ed, and Ellen, it was somewhat a missed opportunity for some teachers in the department. However, the administrators at Site 2 did provide the time and place for teachers to collaborate. Ellen stated, "I think all groups meet at least once a week. You

know? Some meet more often. So, do we all use it? Yes. I don't think we could have gotten by without it. Use it to its fullest ability, I'm not so sure" (Interview). Their continued role in the process sometimes made the participants feel micromanaged or believed that their peers only participated through "contrived" (Laura's Blog Entry) collaboration. Laura suggested that only some teachers in her department used common planning genuinely and effectively.

> Once of the most successful horizontal teams that I'm on regularly engages in "spontaneous, voluntary collaboration." This works because all members have "bought in." I see other teams that are borderline when "developing" teachers where its members are "forced" to collaborate. (PLJ entry)

The participants indicated that more meaningful collaboration took place when teachers chose more convenient timeframes that worked for the whole collaborative group. In the case of Ed, Ellen, and Laura, they chose to meet after school. However, Helen did not meet with her team member because she believed he was unwilling to collaborate. Therefore, she did most of her learning and planning by herself. Helen suggested that the teacher with whom she worked was "not a team player" and was not willing to share his materials. After several attempts to share her materials with the other teacher, she just started planning the course independently.

Mary argued that the administrators at Site 1 had the power to choose what and when teachers taught, and therefore, she asserted that administrators should make a concerted effort to coordinate a common planning period for her mathematics department. Because this structure was not in place, Mary's teaching team alternatively held weekly meetings after school. In contrast, Site 2 administrators provided a common planning period for each department, yet the participants at Site 2 admitted that that it

was not fully utilized. Ellen sympathized with administrators who coordinated the common planning and stated that the task was felt was challenging. “They have to coordinate it. They have to make it happen. They’ve got to work with the schedule, which was really hard. This was an effort, I know, on somebody’s part to make sure we could have time off together” (Interview). Yet, as other participants pointed out, even when there is an opportunity, many teachers chose to help students in their classrooms or work independently.

As with Site 1, administrators at Site 2 had control over teaching schedules. For teachers like Betty and Helen, teaching schedules ended up being one of the toughest aspects of their job. Betty, who teaches mostly 9th grade and 10th grade mathematics, had taught and adapted to three different curriculum changes while working at Site 1. She said that she had created new course materials every year “for the past five years” (Interview). At Site 2, Helen was exhausted by teaching different courses within different collaborating groups. During the time of the study, she was paired with a colleague who she found unreceptive to collaborating or planning with her. As a result, she chose to plan the course independently. She also explained that throughout the school year, her relationships with Site 2’s administrators were strained as students’ parents complained about her teaching approach. The following school year, she was given two different subject areas to teach for which she was the only person teaching both courses. The course newest to her did not have a textbook. Instead of working in isolation by choice, she was working in isolation because of her administratively assigned teaching schedule, and she was “miserable” (Follow-Up Interview).

Ed and Ellen both made positive comments about principals. During the few first years when they were both teaching at Site 2, one principal explained that when working with students of varying abilities, it was not acceptable to leave the most reluctant students behind. Ellen recalled being frustrated with what the students could not do, and the principal told her that she needed to "reach down, and find them where they are, and bring them up to where you want them to be." That comment left a lasting impression on Ellen by helping her to understand that she needed to be flexible with all of her students. Ellen's positive impression of the administrators' role in professional learning was also supported through one of her professional learning images. She included a clipart image of a cartoon dog that was dressed as a doctor and holding a stethoscope. For the image's caption, she wrote, "Good leaders should gently guide teachers to the PD that might help them best… to grow and become better teachers."

Department chairs. The department chairs at both sites had input into the scheduling and in forming the subject-area teams. Department chairs also set the tone for professional learning. At Site 1, the department chair chose not to participate in the study and also did not turn in the survey. During the department meeting, she placed the presentation of this study last on the agenda and quickly dismissed teachers before they had a chance to complete the survey. The survey response rate at Site 1 was less than 70% percent. In contrast, Site 2's department chair, Ed, asked everyone to stay after school for a few minutes to complete the survey (I did not ask him to do this). When I arrived at Site 2, the participants were ready to take the survey and asked me questions about the other phases of participation in the study. Ed completed the survey and volunteered to take part in the study. Additionally, 100% of the participants completed

the initial survey. In comparing the participation between Site 1's department and Site 2's department, there could be a relationship between the department chair's willingness to learn or participate in professional learning and the teachers' willingness to learn. It could have also been a perceived power issue because Ed was in a position of power, which caused the other members of the department to react in ways as to not disappoint Ed or get themselves in any trouble. Although I explained to each of the participants that their participation was voluntary, all of the Site 2 teachers completed the survey, and 53% of the teachers indicated they were willing to participate in the study. Only 25% volunteered to participant in the study at Site 1.

At Site 1, participants discussed their relationship with the department chair as give-and-take power struggles. Betty, for instance, participated in the summer workshop (which Lucy discussed) during which mathematics department members collaborated to investigate the new curriculum and to make pacing charts for the following school year. Betty indicated that she was working in a group with the department chair. She suggested that the department chair wanted to teach a 9^{th} mathematics class that year to oversee that the collaborative groups were running smoothly. Betty reflected that throughout the school year, problems emerged within the teaching team. "I don't think [the department head] knew where the problems existed… I think she felt it was *me*" (Interview). However, as details unfolded with another team member, Betty felt that she earned the department chair's confidence back. "I think that she gained some respect for me through this process. So, I think it's different now… I think that the problems got realized" (Interview).

The department chairs also had the task of assigning subject area teams. At Site 1, this was critical because teachers of the same courses gave common assessments, common assignments, and used the same pacing charts. The teachers had to work well together and often shared the load of creating and organizing units for the course. Mary indicated that the subject area teams were productive in that they agreed "on how to teach the new content, on how we would assess the new material, what our pacing would be, what was the best way to teach it" (Interview). During the time of the study, Site 1's department chair asked each mathematics teacher to write a five-year plan to get a sense of their teaching goals. The participants described how the department chair intended to consider what teachers wanted over the long term as she made their teaching schedules. After the schedules for the following school year had been released, I followed up with each of the participants from Site 1 and asked them whether they felt the department chair listened to their requests. Betty indicated that she believed that the department chair took her requests into consideration. Although she did not have any long-term goals because she was looking forward to retirement, her primary concerns were lunch and planning periods. These were the times she wanted to collaborate with Mary. Lucy stated that although the department chair understood her goal with wanting to work with lower-level students, she "did not understand the part about it not being right to have all lower-level or all upper-level kids. I like the mix" (Follow-Up Email). She was disappointed because she wanted to teach more advanced classes. In a follow-up email, she noted, "She gave me the exact same classes. It is going to be really tough next year. I'm afraid of being type-cast and of not getting a chance to teach other things." Mary was also disappointed with her teaching schedule, as she wanted to teach more 10^{th} grade

mathematics; however, she was pleased with the fact that she had lunch with Betty so that they could plan together. “One good thing is that I now have lunch with [Betty], which is good because we always do so much planning together anyway” (Follow-Up Interview).

The department chair’s power in building teaching teams is important. I was pleased that Ed participated in the study because I was truly interested in how he situated himself as a leader within his department. Ed’s philosophy of encouraging other teachers nudged them in the right direction without forcing them into mandated collaboration. He explained that he wanted to encourage and not force teachers to grow professionally. Therefore, instead of mandating change, he preferred to post signs such as the figure below in the mathematics department.

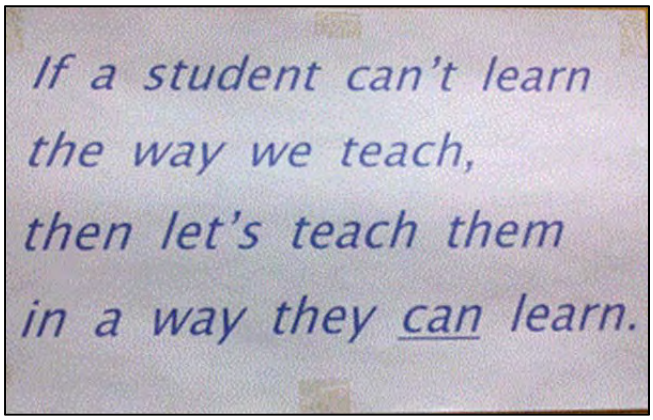

Figure 45. Ed’s Photograph of a Department Poster

When establishing teaching teams, Laura posited that Ed “weigh[ed] both” (Interview) teachers’ content knowledge and willingness to collaborate. During the interview, Ed explained his rationale as he organized teaching teams. “It’s like you’re playing with children. It’s a joy being a department chair… You’ve got to be the grown up with your little six-year-olds, and the rest of them are picking on you, but you’ve got to ignore that. You’ve got to do the same thing sometimes with teachers.” He took into

consideration which teachers worked well with others, personalities, teaching styles, and subject matter knowledge. He also considered who taught the 9th grade classes and who was going to teach the 12th grade courses.

> So you can say, ninth-grade courses, because the students are going to be here for three years, it's important that they get a good foundation, have a good set of teachers that are going to get them off to success for the next three years. You can say that as seniors, we have to get them through one more year. So if you have someone that isn't a team player, and does a lousy job… do you stick them with seniors, saying, "Well, there's no harm done because they're going off to college and it's someone else's problem." Which is not a good way to say that either. (Interview)

This candid feedback was surprising at the time, and then I thought about what the participants in the study from Site 2 actually were teaching. Laura had taught honors 10th grade mathematics and AP Calculus for several years. Ed taught honors AP Calculus as well. Ellen taught honors 11th grade mathematics and regular 10th grade mathematics. Helen had taught 9th grade mathematics for several years. During the time of the study, Helen was teaching 11th grade mathematics and some on-line courses, and during the following year, she indicated that she was teaching the "low-level" seniors (Follow-up Interview). Helen indicated that she thought what she was teaching and who she was teaching (different courses and low-level students) were chosen for her in order to "break" (Interview) her. Given her negative experiences with her administrators (as outlined in her Professional Learning Profile), she assumed that her administrators were "out to get" her (Follow-Up Interview); yet, the extent to which Ed contributed to the changes in Helen's teaching schedule, and to the consistencies among his, Ellen's, and Laura's schedules, who continued to teach the same honors-level courses.

Whether the schedule changes were political or just the luck of the draw, each of the participants was affected by what they were teaching and when they were teaching it.

The departmental policy at Site 1 mandated that the collaborative teams work together to prepare materials for the course. For this reason, teachers like Mary desired more time to plan with peers. Although Site 2 was provided a common planning, the teachers were allowed the freedom to give their own assessments and teach at their own pace. Therefore, more teachers may have chosen not to plan with other group members because the administrative or departmental expectations for collaboration were less strict.

Parents. From the participants' descriptions, the parents within the communities of both Site 1 and Site 2 had a great deal of political sway within the schools. Mary explained why she thought parents moved into Site 1's district. Mary suggested that parental involvement at Site 1 was a double-edged sword.

> They came here because of the reputation. They are interested in the kids learning. They want their kids to be successful. So, even though they don't understand that they have a middle-of-the-road kid [and] they can get a middle-of-the-road education at any of these other schools, they want them here because they think, "My kid has the potential to be here, and this is the school that will recognize that potential and push them up there." … I think for the most part we do, cause you know, it's not—It's okay to be a geek here. I think relating to the parents because the parents do have high expectations. And, they think their child ought to be in this top-level, and this is where they are going to get their top, and they're very involved. They're very, you know, watching the grades. (Interview)

Lucy believed that the parental involvement was one of the worst aspects about the school. "Most of them are not on the teacher's side… I mean, we're accommodating all these kids that wanna take, like, AP classes and all these higher level classes, so it's kind of the community" (Interview). As illustrated by Lucy, teachers and parents can sometimes feel like they are at odds with each other. Helen explained that she was consistently under attack by her students' parents and had little outside support. When her administration approached her about parental complaints, she pointed that the parents

were given “anonymity” that allowed them to “slander,” and “say anything about a person, with no recourse” (Interview). She indicated that the parents were “kind of the driving force at the school” (Interview). Likewise, Laura also pointed out that parents in the community could harm a teacher’s reputation. “But you know, parents are parents. They talk to each other… So, you can get a reputation” (Interview) based on false information.

Helen suggested that her students’ parents provided academic tutors at home for additional support. “The parent can provide money, so they can have computers. They can get on the Internet. They can do all this stuff where, at some of the other schools, they may not have the materials available to them” (Interview). After working at another school comprised of students from a lower socioeconomic background, Helen recalled that her students at the other school appreciated her time more than the students at Site 2 did, who expected to be accommodated. “The kids here expect it. The kids here, they come in when they feel like it because they expect you to be here at 5:30 in the afternoon” (Interview).

Ed found the parents within the community to both a positive and a negative aspect of teaching at Site 2. Although the parents provided support at home and motivated their children to learn, they were also going to “email you every three minutes” (Interview), which ate away at time and took away from doing other professional duties. The participants at both sites believed that the parents believed they had power through their involvement in the schools. They were more likely to contact teachers and administrators, as well as set up parent-teacher conferences. It was during these parent conferences that the participants either learned more about the parent’s perception of their

children and the teachers. For example, Laura pointed out that parent-teacher conferences were difficult because parents did not hold their children accountable for completing their own work.

> The parents more so think it must be the teacher. I think at our school we went through a time where there was a shift in believed power, um, where the parents had a lot more influence. You know, the demands, like I'm going to make a demand. My kid will be in *this* class… The administration somewhat caved. I think it's trying to shift back, you know, now that we've had a change in principal in the past couple years. (Interview)

In contrast, Ellen appreciated the criticism she heard during a parent-teacher conference in her early years at Site 2. As already discussed, after receiving parental feedback that the student was afraid of her, Ellen lessened her rigidity in class quite a bit. Ellen was the exception in terms of learning from parents. Most of the other references to parents throughout the interviews were negative and indicated that there was usually an ongoing power struggle between parents and teachers. Parental over-involvement made most of the teachers feel hen-pecked, defensive, or under attack. For example, some of the participants spoke of parent-teacher conferences in which students' parents expressed criticisms of the participants' teaching techniques. Some of the participants indicated that the students' parents also desired to communicate with teachers and administrators through emails or conferences. Through these interactions, the participants indicated that parents could be either critical of their teaching strategies or excuse the negative behaviors or habits of their children. This was further supported by some of the participants' responses on a survey item that asked them to provide a short description of their school. The participants wrote "parental dominance" (Helen's Survey), "challenging, competitive, and politically correct" (Lucy's Survey), and "demanding, high-expectations, and consuming" (Laura's Survey). Out of all the participant

interviews, blog entries, survey responses, and Professional Learning Journal entries, none of the participants complained about the parents' lack of involvement in their child's education.

Participants' Valuation of Time

One interesting finding from this study emerged from participants' different perspectives of time. One of the open-ended questions on the initial survey asked all the participants to describe professional learning in three words. Some teachers described professional learning as such as "required," "helpful," or "informative," whereas others stated that professional learning as "boring," "useless," "ill-planned," "long-day," or even used the phrase "waste of time." Clearly, there was a connection between the extent to which the teachers valued the professional learning and whether they felt it was worth their time to participate. These free-response answers foreshadowed the connections between believed relevance and how teachers valued their professional time.

As I conducted the interviews, it occurred to me that the participants were talking about time in different ways. During the data analysis process, the various perspectives provided a rich, well-rounded picture showing how teachers valued their time, and in some cases, did not want to give it up for professional learning. From my investigation, the bigger question of what makes professional learning worth the participants' time became critical.

Time to Learn

Betty discussed a desire for more planning time. In fact, she indicated that when she attended mandated professional learning sessions, she would rather be planning. Betty explained that when she learns something new, she would rather have the time to

let the knowledge sink in so that she could figure out what she does and does not understand. “It is structured since I think you need to have a class that's of value to the participants, and it needs to be long enough to where it's useful. It isn't hitting the highlights” (Interview). Therefore, Betty disregarded “sit-and-get” sessions in which facilitators demonstrated software programs but did not allow her the time to become acquainted and proficient using the program on her own. She described the county-mandated technology proficiency workshop as “a good course for me” and explained that she was given several months to learn and use various types of technology programs “where we learned Excel, PowerPoint, and Word. There was enough time spent on the programs to actually be able to use them and to apply them to classroom tools. I mean, we had that much time” (Interview).

In contrast, the curriculum changes in her state made Betty feel uncomfortable because she expressed that she did not have the time to prepare for her courses. Her issues with technology and the curriculum all pointed to same conclusion. Betty felt that she needed time to prepare in order to learn, and in order to prepare, she had to have time to organize her thoughts and materials. Additionally, Betty implied that age, which somewhat quantifies time in a very personal way, influenced the content of what learners could actually learn. Betty said that she was too old to learn to teach calculus, and that her students are too young to appreciate real world applications of mathematics. Time is a restricting value for Betty and for her students.

Similarly, Helen felt confined by the time constraints of professional learning, and indicated that the common planning provided by her administration produced contrived congeniality within her mathematics department. Helen stated that her administration

provided a common planning period so that teachers who taught common subjects could collaborate and plan their subject areas. However, Helen asserted that many people just attended on the days when the administration attended to observe the teachers' collaboration and that her team in particular was reluctant to collaborate otherwise. Therefore, she spent a great deal of time planning for the course after school, during her spring break, and at home. Within this context, time became an obstacle for Helen to meet her professional goals.

> Time. Sometimes. I'm up extremely late at night. Um, I fall asleep, but that's how it goes. It's, uh… yeah, time. I tend to not let things get totally in the way. I get things done. Unfortunately it's a detriment to my health sometimes. (Interview)

Helen sought relevant professional learning to address her immediate needs. In fact, she preferred online learning because it provided her more control over her time given that she could learn at her own pace. "I can adapt it into my schedule. Since I'm so busy right now, I can do it at my own pace" (Interview). Through these examples that Helen provided, her time for professional learning was either provided by her administration or herself. Ultimately, she found online learning to be more beneficial as it gave her additional control over when she participated in the activities.

Mary felt that time restrictions limited her as to how much she could learn at one time. She pointed out that she had to narrow her learning goals so that she could focus on one tool at a time. When discussing technology that she was interested in learning, like a SmartBoard, she stated, "It's like these fantastic things that we have at our fingertips—no idea how to use. Don't have time to figure it out" (Interview). Mary desired to spend time with technology in order to learn it. She used her document camera has an example.

> You have to make yourself do it. So, unless you are really in a situation where you can, not necessarily even be trained, but have someone there that knows how to do it, and have you work where when you come up with questions they can tell you the answers to them. And, we just don't have the time to do that. We just don't have the time. (Interview)

Helen, Betty, and Mary illustrated that they felt that time restrictions limited how well they could learn, what they could learn, and how much they could learn at one time.

Time and Educational Persistence

Ellen spoke of time as an uncontrollable variable that impacted her educational context. For example, she described how time and technology have shaped how teachers and students seek out information. Compared to her learning and teaching experiences from over 20 years ago, she pointed out that she thought that knowledge was much more accessible than it was in the past.

> Now, it's if I can't get it, I'll look online and I'll find it. So our knowledge is way more now, instantaneous. I can find it now. Let's face it, my cell phone can answer half my questions. (Interview)

She also pointed out that the relationships between time and technology influence students' persistence in solving problems. Ellen said that for many years she volunteered to interview students for a prestigious student summer institute in the state. She noted that students answered questions about problem-solving and time much differently today than they did 20 years ago.

> We ask the question, what's the longest you ever spent working on a math problem? Um, ten, twenty years ago, people would say, "Oh, I spent four or five days working on this." A couple years ago, and by a couple I mean five, ten years ago, we'd get, "Oh, I spent four or five hours." Now we get, "Oh, I probably spent twenty minutes." And they think it's a long time. And it's funny how that persistence, you know, changes. (Interview)

For Ellen, time has larger implications for how learning takes place. Now that knowledge is acquired more quickly, her concern was that students (and teachers) learn

less deeply. This was the primary reason she was critical of online learning. “The self-pacing wasn’t bad, but I don’t think it had what I wanted to learn. I needed more interaction to be able to learn. And I don’t feel that I learned deep enough.” For this reason, she resisted online learning to embrace collaborative learning in which she could work with other teachers who had positive attitude toward learning and collaborating.

During his interview, Ed also explained that he perceived a change in his students. He recalled that approximately 10 years ago, about 25% of his students could find a conics application on their calculator, and that “they would start spreading the word.” Then he would have to structure his tests differently so that those who knew about the application did not have an unfair advantage. However, he believed that his current students did not explore their calculator in the same way.

> No one knows a thing about an app. Doesn’t matter if it says right there “apps.” You know? We can do conics we can test over them, we come back the next day and say, now those of you who used the conics app, you realize that question three and question five, you can do it two steps. They’re going, conics what? (Interview)

Time for Making Choices

Lucy indicated that her time was controlled by others. She conceded that she attended most professional learning sessions because her administration, state, or local officials was required her to attend. However, she admitted that if she had the choice to attend voluntarily, she hoped that she would choose to go the provided professional learning opportunities, but then she wavered and admitted it was “another week of summer” (Interview). In Lucy’s view the worst professional learning experiences were time-wasting activities. She went to the original summer-held week-long session related to the content she was going to teach the following year. Then, at the beginning of the

following fall semester, she was required to attend another session that covered the same material as the first session, and she noted that the second session was facilitated by her colleagues from the first session. She indicated that if she had been given a choice to attend the second session, she would not have gone if she had known that the session was not covering anything new.

On the other hand, Lucy also participated in a series of professional learning sessions that her mathematics department provided. In order to prepare for upcoming curricular reforms, mathematics teachers who participated were broken up into common subject area teams. Together, they studied the upcoming curriculum and mapped out the units that they were going to teach for the following school year. Lucy valued this experience as a time-saving activity. “I’m going to have to do it anyway. So why not go do it with everyone and be on the same page and get it organized—group of people instead of on my own” (Interview). She attested to learning about “the new curriculum and… how far in depth we are going to talk about certain things and… how it should align” (Interview). In a sense, she volunteered to attend the sessions in order to adapt to future mandates. Although she understood the relevance of the professional learning standards from this perspective, Lucy’s account also revealed that she attended professional learning sessions in order to help her cope with curriculum changes down the road.

Laura also indicated that her time, to some extent, was controlled by others in that she was mandated to take a certain number of professional learning classes in order to renew her teaching certificate.

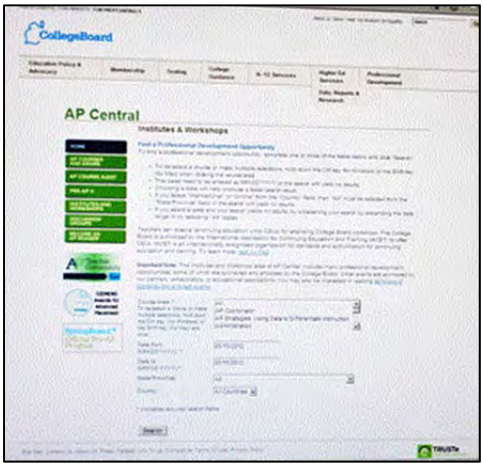

Figure 46. Laura's Photograph of Website to Register for Online Professional Learning

"My certificate needs to be renewed. It's time to go get a bunch of classes." She pointed out "the reason I took that one is just cause that is just reflective of you've got to go online. You've got to sign up for a workshop" (Interview). She said that her photograph illustrated that teachers had the freedom to sign up for when and what they were going to take within "the constraint" (Interview) of having to renew a teaching certificate every few years.

Time and Motivation

For some teachers, time served as an agent to motivate learning. Both Mary and Ellen discussed how the advancement of time itself contributed to changing educational contexts. Therefore, teachers should be obligated to professionally learn because the "clock never stops moving" (Interview). Pointing to her photograph, Mary explained that over time, technology evolves.

> Yeah. That's the reason we have to have professional [learning] because time constantly changes things. We're constantly having new software, new textbooks, new problems in the world… I'm focusing on technology because I feel like that's what the time is constantly changing now. (Interview)

Figure 47. Mary's Photograph of a Clock

Ellen expressed a similar sentiment when she rationalized why some professional learning should be required.

> I feel like one, teachers need to keep up with the new trends for the new education systems. Or what, duh… so yes, I feel for information sake alone; teachers need to be required to have updates on what is happening in their curriculum. (Interview)

School contexts change, and teachers needed to be able to adapt. Mary equated a once unchanging educational context to what is happening within educational contexts of the 21st century.

> You know that story about Rip van Winkle who fell asleep for one hundred years and he woke up and he couldn't recognize anything and then he walked into a school and he goes, "OH! I remember this!" because everything was just the same, right?... I think they are starting to realize out in the real world that, um, the old way of doing things doesn't really prepare you for today's world. Today's world is full of technology, and today's world is full of collaboration… It's just not the same world where it used to be… Technology does make life better. (Interview)

Laura's photograph of calculators illustrated one example of a technological evolution.

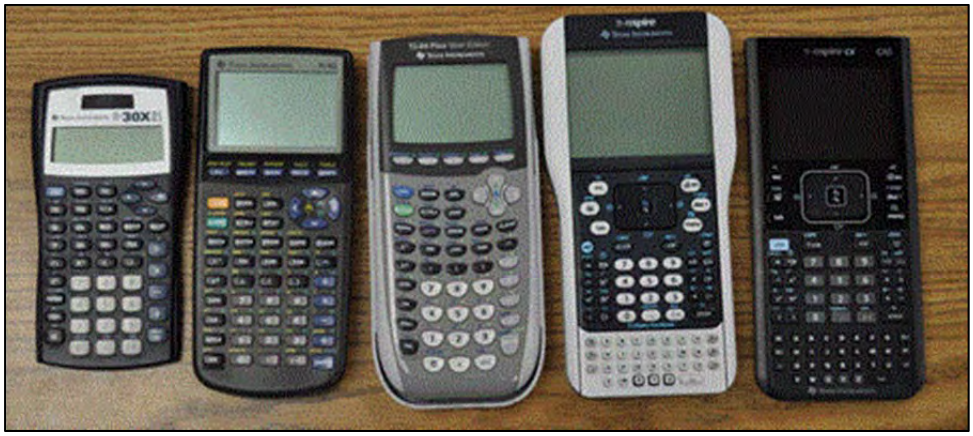

Figure 48. Laura's Photograph of Various Calculators

Laura asserted that mathematics teachers are "expected to know how all of these [calculators] work, and even though this may be today's technology you better know this technology too… Technology has evolved, but… it's not like we got to throw those away… We're just constantly building... our toolbox" (Interview). Innovations not only influence tools for the classroom, but also how students are interacting with each other when they are engaged and sharing ideas. Within her Professional Learning Journal, Mary wrote that she believed two major barriers to professional learning—funding and time. "With all the new curriculum and technology changes, there is a great need for trainings but no money. As a result, teachers don't want to give up their time for free." Both Ellen and Mary posited that teachers should learn in order to adapt to their educational contexts as they evolve through curriculum reform, technological advances, and changing societal norms.

Time and Professional Priorities

Laura insightfully observed that different teachers within her department prioritized their time in different ways. "Successful collaboration is really dependent on

the personalities, experiences, willingness, attitudes and egos of the team members. When it comes to working with other team members, some teachers are not 'professional' at all" (Blog Entry). She asserted that her colleagues prioritize their time and perceived this as a direct reflection of their willingness to collaborate. She used her hallway photograph (Figure 47) to explain the differences among the teachers' perspectives.

She explained that there were many "individuals" (Interview) in her department who could learn from each other, but did not prioritize the time for collaboration. In addition, Laura felt that teachers who left early did not push themselves to improve their practices. She expressed that the teachers who left early, instead of working late, appeared to professionally take the easy way out.

Figure 49. Laura's Photograph of a Hallway with Opened and Closed Doors

> I took this picture because there's [*sic*] lots of doors closed. So, and it's, you end up going to the same open doors all the time… I would tend to say the teachers that are the 8:30 to 3:30 teachers are not pushing themselves… Maybe the assessments they give them, year after year they are the same assessment or something… They're not grading for, um, partial credit… They're almost just very routine… I think about the teachers that work much different hours, are constantly innovating, and

> developing new things… It doesn't feel like in our school that we have a happy medium… The teachers that do kind of do that 8:00 to 3:00… [are] more than willing to receive… but not give back. It's not a one-on-one, it's not a one-to-one kind of relationship… It's the same doors that are always closed and open. You know, and the proportion is about the same… The attitude goes with the closed door, too. You know, when we're like in a department meeting, there's people that will just put their little, and then, though put their two cents worth, and it's not necessarily productive, a productive two cents, you know what I mean? And then off they go to be individuals again. So, I think probably for me here, that the, the big picture here is just, there's really not a lot of community. (Interview)

Therefore, from Laura's perspective, time management not only constrained professional learning, it represented a larger philosophical difference among her peers that influenced how teachers interacted with one another. During the interview, I asked Laura whether she considered herself an "8:30 to 3:30" teacher or an "8:30 to late" teacher, and she stated that "it depends."

> My hours are also sometimes at home and bringing big bags and all kinds of stuff home… It has a lot to do with the fact that I have kids, whereas some of the other teachers… don't have kids anymore… If I could stay here and work that would probably be better, so I'd never brought [*sic*] anything home. But I choose not to do that. (Interview)

Ed echoed Laura's connection of time management and teaching priorities during the interview. He pointed out that from an administrative standpoint, professional developers need to consider both time management perspectives. Ed implied that part of his role as a department chair was to motivate others to engage in professional learning. "School's changed a lot… I'm not sure the teaching has changed a lot." He pointed out that some of the teachers in his department are "very resistant because some of them are of the view that 'this is the way I've always done it,' this is 'has always worked,' … and so, there's no reason to change." Although he attempted to encourage collaboration and change within his department, Ed suggested that the mentality of his teachers, to work

from, as Laura stated, “8:00 to 3:00” or “8 to late,” was an indication of how teachers balance their personal and professional priorities.

> You have some teachers who are only going to do things if it is, um, school time... That’s a fairly sizeable chunk of people. You also, then, have another group who’s philosophy is very much, students is what is really important. I’m here for the students, okay? Yes, I want to do professional learning and all the rest of it, so it has to be on Saturdays, it has to be in the evenings. It has to be any time that’s not being taken away from the students... Well those two don’t overlap. (Interview)

Therefore, if one has two different mindsets about when to learn, it is difficult to please everyone. Ed linked a student-first perspective with time management and personal verses professional priorities. During their interviews, both Ed and Laura posited that “8:00 to 3:30” teachers acted as individuals, not team players, who were teacher-focused, reluctant learners—not student-focused, not open-minded learners. Regardless of how accurate their perceptions were, the fact that some of the participants judged other educators based on the time they left school at the end of the day was important. Ed and Laura brought up salient points. They perceived that their educational philosophy was different from other teachers who left early, and the reasons that their colleagues left early was an indicator of their educational ideology and time management priorities. Ed pointed out that it would be difficult to meet needs of both groups of teachers—those who left early and those who left late—and questioned how the learning needs of both groups could be simultaneously met.

In light of this finding, I followed up with each of the participants and asked them whether they left school early or worked late in the afternoons. I also asked the participants for additional descriptive data, such as whether they were married or had children. Table 7 summarizes the participants’ responses. The female participants who

had children tended to feel torn between balancing their personal commitments and living up to professional expectations.

> I already work probably easily ten-hour days, you know, and bring home stuff on the weekends. I mean it's definitely, so, it definitely affects it… I coach… My family sacrifices a lot. My husband, (laughs), my husband calls, um, teaching a 'hobby' for me. It comes down to the fact that he makes probably three to four times what I make… I will put more hours in the day than he does… He is extremely supportive, but when you get back into this sort of family dynamics, usually the person who is the "ultimate bread-winner," the person who's not... picks up more of the load at home. And, there are times that that doesn't happen. (Laura's Interview)

During the interview, Laura explained that she had to become more "selfish" (Interview) with her time in order to take care of her children. If her son needed to go the doctor, she had to take a day off from work. However, she noted in reference to being a mother, "I have to do it. It's my job" (Interview).

How do other participants perceive family dynamics influencing their professional responsibilities? Lucy felt more pressure to become a coach and sponsor clubs because of her family dynamics. "I feel like being young and having no kids [the administration] expects more involvement from teachers" (Interview). For Lucy, high expectations are imposed by an authority figure, and she felt pressured to be involved because she did not have children. It is almost as if Lucy believed that being young and not having children made her more vulnerable to having her professional time assigned *for* her.

Other participants spoke of their challenges balancing being both a teacher and care-giver. Helen was working because she had children in college. Laura felt guilty that she was neglecting her other "job" (Interview) of being a mother. Mary said in a follow-up interview that she would have already left the field if her husband was working.

Ellen and Ed were married with no children and did not complain of any additional professional expectations that could have been imposed on them. During a follow-up interview, Ed and Ellen indicated that they enjoyed professionally learning together. They were on the same schedule in terms of working late during the school year, volunteering with Math Team, and attending professional learning sessions during the summer. Ellen noted that they had more time for traveling together because they did not have any children, and because they both shared a passion for teaching mathematics. Separately, I asked both Ed and Ellen how their professional learning or career path would have changed if they had not married each other. Both noted that they probably would not be able to work late hours and would have to decrease their involvement in Math Team. Ed indicated that he would have to give up some things at school in order to make other responsibilities at home a priority. When I asked Ellen the same question, she indicated that she did not think she could be with someone who did not understand her passion for teaching mathematics. For her, it was a "way of life" (Interview). She recalled that before falling in love with Ed, she dated an English teacher. He left teaching because he decided that it "was not for him." He then asked Ellen to marry him. She said that she turned him down because he did not understand a fundamental part of who she was because he did not share her passion for teaching.

Participants who were married to non-teaching spouses indicated that they struggled to find time to for professional learning. During the interview, Laura discussed how those who teach and have children have a more difficult time growing professionally.

> I definitely thought about my kids are grown and gone out of the house that I may become a different… I think about the people that I would call

> really highly successful, even in our math department, are highly effect… [*sic*] don't have school-aged children.

Did she believe that teachers who did not have children make better teachers? No. She asserted that *some* teachers who do not have children may still be ineffective teachers. However, she also suggested that she believed that few teachers could balance being a both a dedicated teacher and parent.

Ed and Ellen do not have any children. It seems that their synergy in combining their professional lives and their personal lives contributed to their personal identities. Both of these teachers indicated that they worked later hours. Ed, in particular, indicated that he would rather not have professional learning during the school day as it would detract from the time that he would have for to students during his lunch period. For example, he said, "I'm sorry I couldn't meet with you last week. We've got an AP exam coming up in a week. My kids need me a whole lot more than you need me" (Interview). In contrast, Laura, with both parenting and coaching responsibilities, pointed out that she would rather engage in professional learning during the summer so that she could completely immerse herself in the process without being distracted by other school-related factors.

In terms of professional learning, Ed suggested that professional developers offer time-oriented solutions that fit the varied needs of teachers.

> This is not a one size fits all… You have some teachers who are only going to do things if it is school time. So, therefore, it has to be on your common planning, it has to be on in-service days, okay? You have to provide a sub to take them out of class, that sort of thing. (Interview)

During the interview, Ed pointed out a state-wide problem. Ed indicated that as the curriculum changes, educational leaders at the state-level expected teachers to write

curriculum units and lesson plans. However, Ed explained that "unfortunately the state's philosophy seems to be, it's an 8 to 5 job. We're going to take you out of school. We'll pay for a sub" (Interview). However, he asserted that there were mathematics teachers at Site 2 who were capable of creating quality curriculum units who did not want to be taken away from their students. He felt that these teachers would rather work on a Saturday. Ed believed that there was a philosophical divide on this issue within his department, and that the two groups were approximately equal in size.

> I have probably about half the department who will not do anything… outside of school. I have about half of them who are very unlikely to do things during school if it takes them out of their classroom, away from their kids. And that's really bad because that even means that they are somewhat reluctant… do it during our common planning period when I don't have class, because I have students that come in for extra help every day… I'm working with three kids, every day [during lunch]. (Interview)

Although Ed's opinion of his colleagues within his department could not be validated, he still raised a salient point about developing professional learning that takes into account both perspectives of time management: those who prefer to attend professional learning opportunities during the normal school day schedule and those who prefer professional learning that takes place after school, during the weekends, or during the summer. With such different perspectives on how time should be used, time management becomes a much more complex construct for professional developers to consider. The practical implications for this finding will be discussed in more detail in the following chapter.

Table 7
Summary of Participant Professional Learning Contexts

	Betty	Mary	Helen	Lucy	Laura	Ed	Ellen
PL Context							
When PL Occurs	• Lunch • After school • Inservice days • Summer workshops	• Lunch • After school • When mandated sessions are offered	• Lunch • After school • Spring break • When online classes are offered	•Throughout the school day • After school	• After school • Inservice days • Summer break • Common planning	• Lunch • After school • All year long	• Lunch • After school • All year long
Where PL Takes Place	• Site 1 • Mandated sessions in her school district or state	• Site 1 • Mandated sessions in her school district or state	• Site 2 • In her classroom • Online	• Site 1 • Mandated sessions in her school district or state	• Site 2 • Online courses • Mandated sessions in the school district	• Site 2 • Home • State and national conferences	• Site 2 • Home • State and national conferences
Contributing Factors to PL Contexts							
Departure time from school. (3:30 or late)	Late	• During the study, late. • After the study 3:30	Late	3:30	• During the study, late. • After the study 3:30	Late	Late
Marital Status	Single	Married	Married	Married	Married	Married	Married
No. of Children	0	2	2	0	3	0	0
Other Professional Duties	No	No	No	• Coaches fall and spring sports • Sponsors two clubs	• Coaches a spring sport	• Math Team • Mathematics department chair	• Math Team • Gifted department chair

Desired Resources for Professional Learning

During the interviews, I asked the participants how they would learn to teach a new course. Regardless of the participants' years of teaching experience, age, or hypothetical content matter which they were preparing to teach, all the participants initially began the learning process by using resources such as technology, books or Internet references in order to become acquainted with the curriculum. As the participants described this learning process, commonalities among their preferred resources emerged, yet their applications of these assets within their learning process differed. For example, some participants, such as Helen and Laura, indicated that they preferred to use textbooks to independently gain precursory knowledge of the mathematical content they were going to teach; however, Ellen used textbooks to gain knowledge of her content while also collaborating with other teachers who taught the same subject to gain their insights and interpretation of the textbook material. Other examples of how the participants used resources differently are discussed in the following sections.

Textbooks as Resources

All participants described a need for familiarity with the content they were to teach, and they chose to learn about content through their course textbook. Laura indicated that hunting for information could "be almost overwhelming," in that the different resources provided "answers to so many different things" (Interview). She compared the process of searching for resources to going into a library not knowing where to begin.

Laura did not discuss what she did with the textbooks once she located the one she was going to use. However, both Ed and Ellen indicated that they would seek out

Figure 50. Laura's Photograph of a Bookshelf

more than one textbook on their topic in order to cross-reference the curriculum. Ellen described how she used these resources to reflect upon mathematical methods and definitions that the textbooks provided. "I would sit at home at night with, like, three books, or four books, or five books around the floor, going, 'I like the way this does this, but I like this method. This is good language. I like this definition'" (Interview). Helen also used textbooks to learn content, and she explained that her photograph of a computer and a textbook was "basically how I've been doing any of my learning has been Internet and the book" (Interview).

Figure 51. Helen's Photograph of a Binder, Textbook, and Laptop

Universally, a class textbook was one of the first resources mentioned by each participant. They all used the textbooks to become familiar with the content area. Afterward they would seek out other resources to help them determine how to teach the material.

Online Resources and Technology as Resources

The teachers also used technology to learn how to teach a new course. For example, Mary preferred to watch videos online of others teaching her course in order to "see people actually teaching it, and… be a student in their class" (Interview). She indicated that she would observe several different presentations when she was uncomfortable with her topic to help her better predict the types of questions the students would ask her.

Participants who felt more isolated in the learning process, such as Helen and Lucy, more often turned to Internet resources, technology tools, and online learning. Helen indicated that she enjoyed using the Internet for a number of reasons. First of all, she asserted that she learned more about her content through websites that summarized and explained the material. Helen indicated that informative websites allowed her to immediately access the information she sought from convenience of her laptop. "Most of the time, anything I do, I go to it myself. I don't wait for things from here" (Interview). She also embraced online learning, as this option gave her more power and control over her learning pace and goals. "I can adapt it into my schedule. Since I'm so busy right now, I can do it at my own pace. I like that. I'm not one who has to have someone over me" (Interview).

The participants drew on a variety of technological resources in order to become acclimated to their content knowledge. Most often, the participants would also diagnose what they did not know, and then seek out peers or mentors for help. However, the participants only reached out to these resources once they had developed some sort of baseline knowledge of the curriculum.

Interactions with Peers

The participants contacted others for help for various reasons. Additionally, their interactions and types of help they desired varied. For example, Mary conveyed that she did not want to waste her peers' time by asking questions that she could figure out herself. However, when she was prepared, she was primarily interested in getting advice on how to present the material and how to help students make curriculum connections to the larger picture of mathematics. She also wanted a schedule that allowed her to observe her peers as well as "common planning with someone else who teaches it" so that she could ask questions about the course. She also suggested, "Maybe… if my lunch period was during someone else's class, where I could go actually observe them. That would be good, too… I think the common planning is really huge… because you are going to have questions every single day" (Interview).

The teachers also sought out their peers for tangible resources and teaching ideas. For example, Lucy indicated that after she worked out all of the problems and made her class notes, she wanted to sit in a peer's classroom daily in order "sit in and watch someone teach calculus" (Interview) while taking notes. She said she would record the topics that brought about interesting discourse in class, in case it was inadvertently omitted from her materials. In a sense, she wanted to observe the class dialogue in order

to perfect her class notes. Betty, Helen, Laura, Ed, and Ellen all expressed a need to work with peers in order to obtain or share curricular materials. However, across these perspectives, there were increasingly subtle differences regarding how the participants networked, interacted, and shared these resources as they worked with others. For example, Betty simply wanted reach out to her peers within her school to see and utilize the resources that they had already developed. In contrast, Helen, Lucy, and Laura all desired to conduct peer observations in order to observe how others taught the content, modeled instructional practices, and also anticipated their students' mathematical misconceptions through the classroom. Therefore, each participant wanted to preview the lesson in order to get a "practice run" as to how the lesson could be presented in his or her classes.

In addition to observations, some of the teachers wanted to share curricular materials such as worksheets, tests, and activities. Helen, in particular, sought out her peers within her department to answer content-related questions, and she also called mathematics teachers outside of Site 2 to share additional materials, such as assessments, assignments, or pacing charts. None of the teachers at Site 1 indicated that they desired to network outside of their school. However, Helen, Ed, and Ellen all viewed their peers at other schools as resources and indicated that their relationships with these colleagues were maintained simply by picking up the phone and calling for help. For example, Helen explained that when she was learning a new topic, her phone allowed her to seek out help from others. "Most of the times when I don't, I get on the phone. Or I'll write down the question, and I'll say, okay, I have to get back to you one this. So sometimes I call [a peer], sometimes I call [another peer]" (Interview).

When describing their approach to learning a new topic, both Ed and Ellen indicated that their desired methods of collaboration were techniques that they had already successfully used in the past. By coaching Math Team, they formed small, close-knit networks of teachers who were teaching a new course for the very first time. Ellen painted a picture of sitting on her living room floor, surrounded by various textbooks for a precalculus course, and she recalled how she called up her peers at other schools to ask them for their perspectives of developing the curriculum. She asked her peers "How are you going to do this? How are you going to develop this? … Have you seen this book?" (Interview). Additionally, Ellen and the teachers within this small network shared assessments and materials as they made them. Unlike Helen, who also reached out to peers outside of Site 2, Ellen used these small learning communities to create her knowledge about the course through constant and continuous peer dialogue. Additionally, as they developed materials, they received and shared materials with other members within the group. Teachers within Ellen's learning community were all learning from and communicating with each other. In contrast, Helen called on her peers at other schools to gain materials or ask pointed questions. Helen did not indicate whether the teachers from whom she sought for help were working together. Both Ed and Ellen referred to Ellen's early experiences of networking and communication as an exemplary case of how they preferred to learn something new. Although it may appear that they were interviewed together, they each brought up Ellen's experience of learning through this small learning community during their separate individual interviews. Ed even asserted, "I'd approach it that way" (Interview).

When the participants in the study described their interactions with their peers, they usually described positive interactions in which they planned with, learned from, or learned with their peers. Through these relationships, peers became cheerleaders, mentors, collaborators, lifelines, sources of knowledge, teachers, and sometimes even roadblocks. An interesting finding from this study was that although each of the participants discussed learning with their peers, *how* they learned with their peers uniquely fit the self-ascribed learning goals of each particular participant.

Planning with peers. Mary and Betty collaborated and taught together. Both of these participants indicated that they wanted time to plan with their peers. Although Betty enjoyed watching her peers to help her learn how to use Texas Instruments (TI) InterActive!, or whether they were both making time after school to meet with their subject area team, both of these teachers prioritized making the time to plan. Betty suggested that the best types of professional learning were “interactive with your peers when you are planning” (Interview). As she gestured to a photograph of two teachers looking at a document together, Betty explained that “together we're looking at those standards in determining what it actually says.” Her photographs supported her statements about collaboration. Several photographs illustrated students or teachers working together.

When they described negative learning experiences, both Mary and Betty indicated that they would rather have been planning for the school year instead of sitting in that particular professional learning session. The main barrier to this type of professional interaction was time. For that reason, Mary emphatically stated that she wanted her administration to provide a common planning period. Because her

administration did not, Mary's subject area team decided to make meeting times for planning mandatory:

> It had to be mandatory—the people who griped still admitted that they got a lot out of it, and complained if they felt left out of the process… I really believe that the common planning should be with people who teach the same subject, and even level student, that you do. With the initial change in curriculum … a few years ago, we decided as a team to have required meetings once per week-this was great!

Therefore, even when common planning was not provided by her administration, Mary (and her teammates) still found a common place and time in which to collaborate. However, Mary still felt that having a common planning period during the school day—not before or after school—would be "ideal" (Interview) in that they would be able to have "professional learning every day " (Interview). Ironically, teachers at Site 2 were not utilizing the common planning time that they were offered. The teachers at Site 2 planned to meet with their group during times that were most convenient to each member, which was sometimes different from their planning period. However, Laura and Helen pointed out that even when teachers utilize purposeful time for planning, they may not be learning anything. When Laura was asked whether common planning promoted professional learning, she responded, "Is there much professional learning going on during that common planning? I would tend to say no" (Interview).

Learning from peers. Betty disliked her experience as a floating teacher because it hindered her ability to prepare for her courses. Lucy, however, enjoyed the experience because she was able to observe several different teachers throughout the day. Recalling it as one of her favorite learning experiences, Lucy pointed out why she loved to float through a blog entry.

> Floating into a different classroom each period was great because I saw other teachers' styles of setup, how they ran things, and I could ask them for suggestions since I had another experienced teacher in the room with me. From this I learned different management styles and ways to collect homework, tardies, etc. I totally stole ideas I liked from certain teachers to incorporate in my classroom now.

Therefore, the same activity of floating was interpreted differently by Betty and Lucy because the activity, floating into other teachers classrooms to deliver mathematical lessons, either met or did not meet their learning goals. For Lucy, floating met her class management and organizational learning needs by exposing her to a variety of styles on a daily basis. Lucy suggested that she liked having a support system of teachers to ask questions when she needed help. From an assimilation standpoint, she had a support structure of peers built into her flexible classroom structure through her floating experience.

Other teachers learned from teachers through observations. For example, Laura described observing a teacher to investigate her high-energy presentation techniques. Laura indicated that after her observation, she asked herself how the other teacher had such high energy "twenty-four/seven," and she concluded, "Well, no kids. Only has the dog, you know, I'm kind of thinking that's sort of situational" (Interview). Although she did incorporate the techniques into the classroom, the experience made her reflect about her own personal priorities and identity as a classroom teacher. She rationalized that she could not be as high-energy all the time because, unlike the teacher she observed, she was a parent with other important, but not professional, responsibilities.

Ed and Ellen both discussed attending state and national conferences to get "a glimpse" (Ellen's Interview) of what expert mathematics teachers were doing in their classrooms. Ellen described taking a week-long workshop in New England at which she

was able to attend several classes related to geometry and art. From the teacher-instructor and artist facilitators, she observed and learned how to design artistic projects for her students that allowed them to express their mathematical knowledge through creative projects and activities. Ultimately, she implemented elements of the proposed cube project that was presented during the workshop, and she adapted the artistic principles promoted during the session to other creative projects in both of the mathematics courses she was teaching. The learning experience was important because she and Ed left their graduate school experience to seek out other types of learning opportunities, such as the Philips Exeter Academy workshops or NCTM conferences, in which the facilitator was a practicing teacher. As such, Ellen viewed the instructors at this workshop as mentors from whom she could learn.

Learning with peers. Finally, there were a few examples in which the participants actually constructed knowledge collaboratively with peers. Ed, for example, described how he enjoyed problem-solving by himself. However, if he needed help, he sought out a peer that he trusted not to give the solution process away. He wanted his learning process scaffolded so that he could benefit from problem-solving by himself. During the interview, Ed pointed out that if he does not "do" something for himself, he truly has not learned it. In Laura's case, she turned to her students to help build her content knowledge. As she reflected on her learning process, she recalled one of the first time she taught calculus. She explained that she would teach it to herself as if she was the student. This helped her connect with her students as they constructed their knowledge of calculus together. "It was almost like we were a learning community." In this case, I am considering her students as her peers in that she described their content knowledge and

skill level to be similar. They had common ground in this case, and therefore, they helped each other learn the content. Similarly, in the document that contained her images and commentary, Ellen noted that one of the benefits of attending national and state conferences was being able to connect with her peers. “Those connections could create a learning community—as part of a vertical alignment, a horizontal alignment or just a philosophical alignment.” The connection of commonality was critical across all the cases when the participants discussed learning communities.

The participants learned with their peers though constructing knowledge together. For example, when Ellen was first learning how to teach precalculus, she described forming a learning community with teachers who were teaching the same subject at other schools in her school district. As she prepared for the course on a daily basis, she frequently called and discussed with her peers how they would present topics or which definitions from the textbooks they preferred. Together they harnessed their intellectual resources as a group to simultaneously build their knowledge for the course. They also used each other as resources as they shared their teaching materials through the school districts mailing system, a free and timely intra-mailing system for those who worked within the district.

Finally, one of the most notable images of learning with peers comes from both Ed and Ellen. T^3 conference organizers asked Ed and Ellen to facilitate a workshop on using various types of graphing calculators. T^3 is a mathematical abbreviation for the Texas Instruments promoted conference, Teachers Teaching with Technology. Texas Instruments provides regional and international T^3 conferences for teachers to help develop and enhance their technology integration skills. Although Ellen agreed to the

task, she admitted that she did not know how to actually use them. She asked for the resources and the calculators so that she could become more acquainted with the calculator's capabilities, and she and Ed then had a calculator exploration session at their kitchen table. As they brainstormed and played with the devices, she described the humorous scene analogous to "two kids playing with toys" (Interview). She went on to explain that she and Ed just wanted "to share what we just figured out on that calculator… It was in the minute, we had to know it. We wanted to know it" (Interview). Through that necessity, they enjoyed being able to learn by bouncing ideas off of one another.

I found that teachers created knowledge together when they recognized that their partners or group members had similar educational backgrounds. Ellen suggested that similarly-skilled teachers work well together because their "egos are a little more on line with each other, and you're much more able to admit, 'I really don't know how to do this'" (Interview). They had to have a similar learning goal. Whether it was designing problems for a mathematics test or learning how to teach a new curriculum, teachers constructed knowledge with others when they felt they were working with someone on an equal playing field.

In Figure 50, I organized the participants' preferred resources they used as they learned how to teach a new course. Although the participants may have talked about using other materials from previous experiences, I included only the resources they described during their response to the posed question of teaching a new course. I arranged the resources in order of the degree to which human interactions and relationships could be formed. Therefore, resources that required no personal interactions

were at the top of the resource list, and those that required more interaction and reciprocity of materials were included at the bottom of the list. Figure 50 illustrates that all of the teachers preferred to use a course textbook. Additionally, teachers at Site 1 were more likely to use resources at the top of the list that require less human interaction. Although they preferred to observe their peers, they did not discuss generating knowledge with their peers. Primarily, when they sought human resources, they wanted to learn from or observe others.

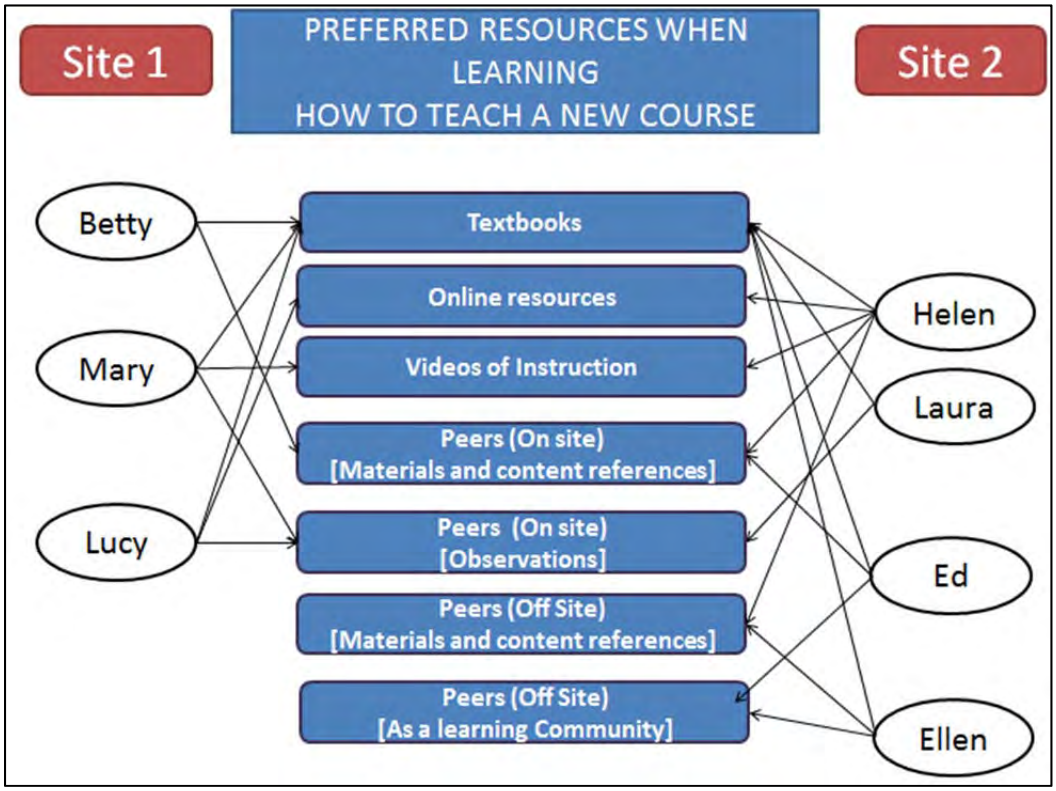

Figure 52. Preferred Resources When Learning How to Teach a New Course

The participants at Site 2 used more of the resources along the continuum. Although Helen, Ed, and Ellen were all willing to work with mathematics teachers outside of Site 2, Helen utilized the relationship to generate additional tangible resources. Ed and Ellen, however, preferred to turn to their peers at other sites more frequently in

order to share materials and discuss the nuances of course. As Ellen described, they created a bigger picture of the course together through all of their perspectives. She was part of a learning community that shared individual perspectives and resources within the entire group.

Table 8
Summary of Participants' Learning Processes and Learning Resources

	Betty	Mary	Helen	Lucy	Laura	Ed	Ellen
PL Process	• Collaborates with peers • Works independently on practice problems • Attends mandated PL sessions	• Brainstorms • Collaborates with peers before and after school	• Works independently • Immerses herself within the content through Internet resources her textbook.	• Enrolls in graduate classes • Observes teachers by floating • Seeks the course curriculum online • Prepares notes for class and went through all the assignments herself to prepare	• Sifts through several texts • Takes online courses • Teaches herself the content from the perspective of a student • Observes peers • Collaborates with students "We're all in it together."	• Solves problems independently • Seeks scaffolded feedback from peers • Attends conferences • Shares ideas with peers	• Collaborates within close-knit groups • Solves problems independently and with peers • Attends conferences • Shares ideas with peers
PL Resources	• Site 1 peers • Textbook • Online curriculum	• Internet videos of others teaching • Site 1 peers to fill in knowledge gaps and to discuss instructional practices	• Textbook • The Internet • Site 2 peers and district peers when she is "stuck" or needs additional resources	• Peers who have taught the subject • Textbooks • Observe peers teaching • Training sessions	• Textbooks • Her Students • Site 2 peers	• Textbooks • Peers in the district	• Textbooks • Peers in the district • Shared resources
Interactions with Peers	• Interacts with peers when she has a question or needs to plan a course.	• Plans with peers • Seeks out more knowledgeable others with content questions	• Asks peers to clarify content or provide resources necessary for planning	• Observes and converses with "respected" peers • Plans with peers	• Observes peers • Seeks out experts to answer questions • Collaborates with students as she learns something new • Hopes to collaborate with peers to plan content	• Seeks out peers when he's mathematically stuck • Attends conferences to give back to younger teachers	• Forms learning community with those who teach similar subjects • Takes feedback from students and parents to heart • Observes expert teachers at conferences

CHAPTER 13: DISCUSSION, CONCLUSIONS, AND FUTURE RESEARCH

The Professional Learning Sequence

Introduction of Stages One through Six

Asking the participants to describe their learning processes from start to finish helped me to understand how they preferred to generate new knowledge while preparing to teach a course. Between the details of the participants' past experiences and their stories of how they would learn to teach a new course, I was able to synthesize their learning experience narratives to develop a broad view of the participants' learning sequence. This model for professional learning is based on the participants' descriptions of specific and discrete learning experiences—not multiple learning experiences spaced out over a period of time. The participants did not describe connected learning experiences in which one experience sparked them into beginning a completely new learning experience. Therefore, the model that I present is not cyclic in nature. The participants provided narratives of professional learning that were very much linear in nature. Even though the participants may not have completed the entire professional learning sequence, they still progressed linearly from one stage to the next throughout the process. For example, the participants could not be engaged in a learning experience without defining a particular goal for that learning activity prior to the process.

The Professional Learning Sequence that emerged from this study includes six stages defined by the following actions: (1) developing learning goals; (2) establishing relevance; (3) participating within learning structures; (4) producing evidence of learning;

(5) transferring new skill, product, or knowledge into practice; and (6) evaluating the effectiveness of their learning. As the participants described positive learning experiences, they provided examples from each stage of the cycle.

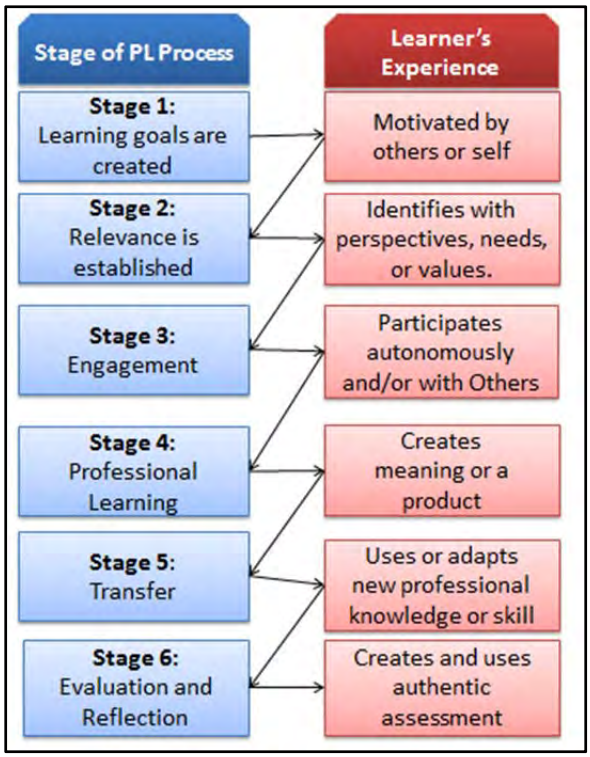

Figure 53. The Professional Learning Sequence

Participants' stories of their learning experiences helped to support the development of each stage. For instance, examples within Stage 1 highlighted who set the learners' goals and defined what goals were developed. In Stage 2, the relevance, or teacher buy-in stage, was supported through the participants' examples of why they justified or disqualified the learning goals as applicable to their profession. Stage 3 encompassed how the participants learned and described the learning structures in which the learning occurred. For example, when and where did learning take place for these participants? Did their school systems provide structures that supported the learning process as it occurred?

The last three stages relate to the product of the learning, whether it was implemented, and how it was assessed if the new knowledge was implemented. Furthermore, the themes that emerged among all the data fit within each of these stages. For example, when a learning goal was established, it was either established by the learner or by some authority figure. The extent to which the participants suggested that their learning experience was controlled by others sparked sentiments of liberation, complacency, oppression, or resentment towards professional learning.

Relationships Among Themes

The topic of professional learning provided a rich context for investigating how mathematics teachers in high performing schools set goals, engaged in the learning process, implemented gained knowledge or skills, and evaluated their learning. The Professional Learning Profiles (PLPs) detailed the participants' perspectives of expert mathematics teachers and their professional learning stories to provide a backdrop through which to investigate the extent to which students are involved in teachers' learning processes. Because the focus of this study was to investigate the participants' perspectives and beliefs concerning professional learning, the interview discussions and other study components focused on the participants' learning, not necessarily the learning of their students. The participants—not the researcher—evaluated the relevance of the professional learning experiences through their discussion of the learning experiences that they either embraced or abandoned.

The Professional Learning Sequence illustrates the typical process for professional learning through the participants' numerous accounts of the process. As teachers moved from one stage to the next, the learners' experiences are shaped through their interactions

with authority figures, peers, students, contexts, and resources. Additionally, how teachers reflect about their experiences during the learning process contributed to their motivation to continue their engagement or implement what they learned within their practice.

Within the extended view of the Professional Learning Sequence, I was able to demonstrate how each stage addresses different questions related to the professional learning process. For example, Stage 1 establishes *what* the learner was learning. This is the stage during which learning goals are either established by an authority figure or by the participant. Learning goals that teachers espoused included technology support, classroom management techniques, curriculum planning, motivating students, problem-solving, and cross-curricular topics. However, outsiders may also develop the learning goals for teachers to include technology proficiency, broad topics on instructional practices, adaptation to curriculum reform, specific technology training related to mathematics, and inspiration for the school year. When mathematics teachers' inherent learning goals are incongruent with the developers learning goals, the teachers are more likely to be critical of the learning experience and choose not to implement the suggested practices or strategies within their own school or classrooms.

Stage 2 describes the teachers' justification of whether the learning goal was worthwhile. If the learner takes part in determining the content of the professional learning, he or she is more likely to find value in the process. When professional developers do not consider teachers' learning needs, they neglect to include teachers' goal-setting process. Established teachers' learning goals also include making clear connections between the professional learning activity to mathematics-applicable strategies for content and pedagogy.

Stage 3 encompasses structures that were in place to support the professional learning context. When did the professional learning take place? Where did it occur? How did it occur? What resources did the learners use or not use during the process? Although teachers' learning goals vary depending on the learning goal, the learners' experiences are the most critical resource for learning. In this stage, authority figures often develop structures for professional learning regarding when, where, and how the professional learning takes place. Independently, teachers also take charge of identifying resources and human support to promote their learning process. Stage 4 summarizes the evidence that the learners provide to demonstrate that they learned something new. During this critical stage in which the learners are exposed to new ideas, teachers decide whether or not to use the professional learning content in their practice. Teachers seek educational evidence to evaluate whether the strategy was applicable to their contexts for teaching. If they deem their new knowledge sufficient to implement, teachers then transition into Stage 5, at which they implement or use their new, valuable knowledge. Finally, in Stage 6, goal setters (either teachers or program developers) assess the effectiveness of the implementation and whether the learner should reuse, adapt, or discard the learned skill or idea for future use. I found that addressing the *who*, *what*, *when*, *where*, *why*, and *how* of professional learning allowed me to more directly, yet fully, address my specific research questions.

As illustrated through each participant's Professional Learning Profile and the themes detailed in the previous chapter, the Photo Elicitation Interviews, Reflective Learning Journals, Professional Learning Discussion Board, and follow-up interviews worked in concert to provide a global, yet teacher-oriented, perspective of the Professional Learning Sequence. Whether negative or positive, mandated or voluntary, short term or

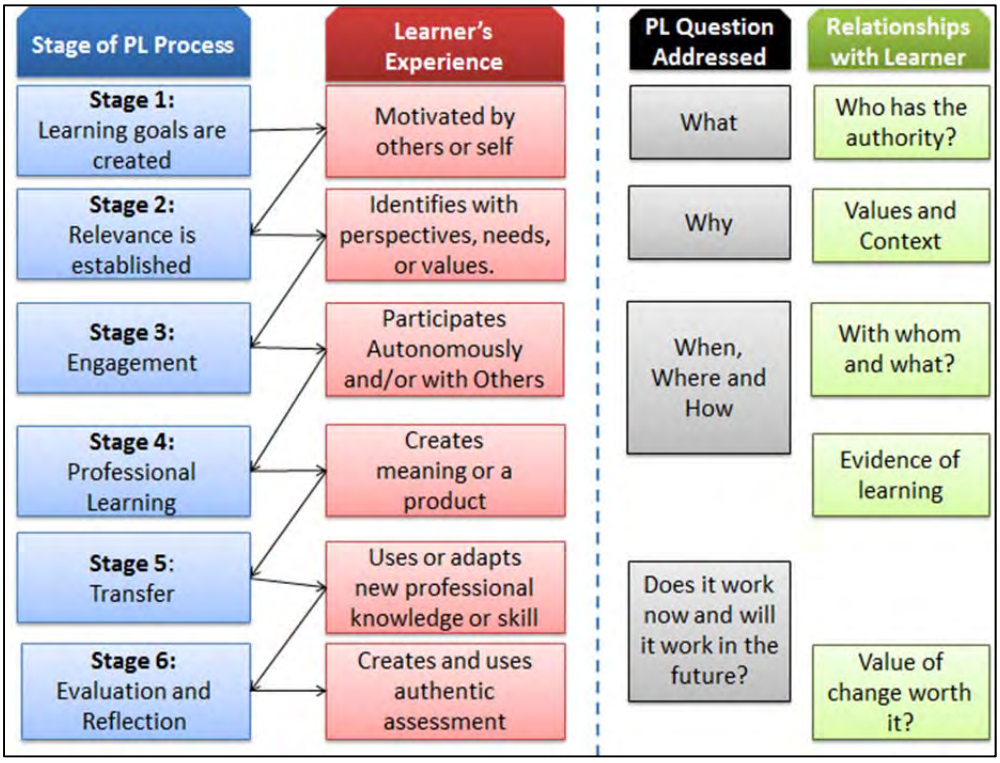

Figure 54. The Professional Learning Sequence (Expanded View)

ongoing, the participants' collections of stories of successful and failed learning experiences provided snapshots that captured the characteristics and contexts of professional learning. For the remainder of this chapter, I use the theoretical frameworks to answer the research questions and situate the findings within professional learning and mathematics education literature. I conclude this chapter by discussing the limitations of the study, detailing implications of the findings, and offering suggestions for future research.

Relevance, goal setting, and learning for understanding. In order to establish relevance, participants need to clearly connect the focus of the learning activity to their values, needs, and perspectives (Wlodkowski, 2003). The findings from this study suggest that teachers who had a sense of ownership over their learning goal or took part in creating the goal were more likely to accelerate the justification process and move forward to Stage 3, in which they are engaged. The participants established relevance, a need to learn, or a

need to develop a skill *during* the goal-making process. As a result, Stages 1 and 2 were completed simultaneously. This finding is consistent with literature indicating that adults are more likely to develop a positive attitude towards learning when they are able to select the learning goal, with whom they will learn, how they will learn, and how the process will be assessed (Wlodkowski, 2003).

The findings suggest there was an apparent link between the participants' perceptions of who developed their learning goals and the degree to which they found the learning experience relevant. Trotter (2006) explained that adult learners "preferred to plan their own direction paths, and most generally chose educational topics and subjects that they could directly apply in their own classrooms" (p.12). Additionally, adult learners are motivated to participate if a learning goal is believed to be "relevant to their current role and transition period" (Trotter, 2006, p. 12).

For example, recall the instance when Betty bartered with her college professor to learn calculus over the summer. At the end of the semester, she determined that she was probably going to fail the course. In a last-ditch effort, she proposed a learning goal, strategy, and promised commitment to that strategy if he would give her a C grade in the course. The immediate and relevant concern was that Betty wanted to pass the course. In order to do that, she developed the learning goal of learning calculus by doing all of the practice problems from her textbook. Once the professor accepted the deal, Betty engaged herself in the learning process by doing every practice problem in the textbook. She felt this experience was positive and asserted that this is how she would prefer to learn mathematical content for teaching in the future.

Teachers who took even a small part in the goal-setting process were still motivated to participate in the activity. In Laura's example of observing a peer, she was mandated to participate in observing another faculty member within her school; however, she had a choice of whom she could observe. Although the administration's goals of peer observations were clearly defined for her, Laura's goal of wanting to observe a particular highly-regarded and engaging teacher was clear. In making her choice of whom to observe, she had to rationalize why observing this particular teacher was important to her. Thus, although the learning experience was mandated, the goal-setting process was flexible. Laura did not criticize her experience. She used the story to discuss how she learned more about her own identities as a parent and a teacher through the observation.

When teachers either partially or fully created their own goals, they were more likely to complete the Professional Learning Sequence. However, when others set their goal for them and excluded them from the process, they indicated that they felt the goal setters did not understand their unique and specific needs as mathematics teachers. During Lucy's interview, she emphasized the idea that others who set her goals "don't really know me at all… Why would you set my, I mean, I see why they set these requirements just because some teachers need it, but I don't think someone setting my goals really makes sense at all." When the mathematics teachers were mandated to go to workshops, presentations, and sessions with teachers who taught different subject areas, they felt as if the goal developers were trying to just teach to what Lucy described as the "lowest common denominator" (Blog Entry). In Lucy's case, she felt that her "standards are a little higher" (Interview). If the participants were mandated to participate in professional learning, establishing relevance

of the learning goal was easier when the content was related to mathematical content or teaching mathematics.

Szatajn, Campbell, and Yoon (2011) discussed six critical elements for Mathematics Professional Development (MPD). They proposed that goals for MPD should include: (1) a common goal for teaching and learning; (2) strong knowledge of the curriculum; (3) an understanding of how students learn; (4) strong pedagogical knowledge; (5) understanding equality in school mathematics; and (6) understanding one's identity as a mathematics teacher. As the teachers established the relevance of their professional learning, they evaluated whether the learning goal was relevant to their practice, personal learning goals, or fit their interests in learning a tool to which they had access and time to learn. However, were all of the self-defined goals addressing a need to adapt to contexts or learn for understanding?

Teachers who *learn for understanding* are motivated to meet their own self-developed learning goals and then they apply their knowledge in order to problem-solve and make rich connections—not to learn an isolated skill (Franke, Carpenter, Levi, & Fennema, 2001). The participants highlighted experiences in which they were included or excluded from the goal setting process. When the goals were set for them and the professional learning was required, the participants were more skeptical of the learning process and rejected mandated professional learning sessions that did not relate to mathematics or connect with a professional learning goal that they had already established. If the learners did not identify with the perspectives, needs, or values of the learning goal, the participants rejected the learning experience and did not make attempts to implement the promoted knowledge or skills into their practice.

When participants described instances in which they were included in creating the learning goal, they did not criticize the relevance of the experience. They indicated the goal of the experience and then described their engagement in the process. Essentially, during the goal-creation process, the participants not only established what they wanted to learn, but they also justified why they wanted to learn it. However, the goals that the participants developed may or may not promote learning for understanding. Some participants discussed experiences in which they wanted to a gain technological skill, build classroom management skills, or plan a course with their peers. In these cases, when the goal was not likened to learning for understanding, the evaluation of the goal was simple. They could use the technology. The course was planned. However, when teachers described experiences in which they were learning for understanding, they evaluated the success of the experience through more dynamic means. Laura found her peer observation to be successful because she gained insight into her teaching identity. Ellen found that her experience of learning to teach precalculus for the first time was successful because she explored the vocabulary and strategies to teach the course with her peers. She indicated that she felt like she was the "most enlightened" (Interview) precalculus teacher because she had constructed content knowledge, vocabulary, and instructional techniques with her peers within her small learning community.

Sometimes participants described positive professional learning experiences in which they learned something they could not implement into teaching practices. In these cases, they connected the content to their own interests, but perhaps not to their profession. For example, Ed mentioned that he may want to learn something just for himself and not necessarily for his students. He may have bought into the learning process as the goal

related to his personal values, but the experience may not have been relevant to his profession. Therefore, regardless of what he was learning, the product of his learning did not make it into the classroom.

When the relevance was linked to their practice, teachers were able to attempt to implement, use, and evaluate the strategy. When Ellen described learning the AP Science standards, she indicated that she wanted to learn them to gain a deeper knowledge of the course and the course standards. However, when she was engaged in the class, she was able make connections between the course she was teaching and the science curriculum. Ellen noted that she was able to use and discuss applications of the scientific method in her class as she helped her students to problem solve. Therefore, she may not have made an immediate connection of the learning goals to her curriculum, but when she did during the engagement stage, her understanding of her mathematics course and some science courses were connected. She could and did implement this knowledge into her classroom.

Engagement and collaboration. Once the relevance of the learning goal was established, the learners moved into Stage 3 and became engaged in the learning process. Wlodkowski (2003) defines *engagement* as the learning process by which the *challenge* is the learning opportunity. The challenge requires the learner to possess some knowledge or skill in order to complete a "goal-like quality" (Wlodkowski, 2003, p. 44). Engagement that challenges learners should embed activities to encourage the learners to search, evaluate, construct, create, or organize "the learning material into new or better ideas, memories, skills, values, feelings, understandings, solutions, or decisions" (Wlodkowski, 2003, p. 44). Although the participants' definitions of engagement are unclear, they described learning experiences in which a learning challenge was not always identifiable. For example, Mary

wanted to have common planning so that she could learn or plan with her peers. She went on to explain that because her department did not have common planning, her subject area team collaborated once a week to plan their course. Although her collaboration team may have had a common goal of planning, the challenge she faced and what she learned was unclear.

Problem-posing is an effective strategy to both challenge and engage learners (Wlodkowski, 2003), and problem-posing would promote engagement through problem-solving, which is an important characteristic of learning for understanding (Franke et al., 2001). When I initially posed the problem of learning how to teach a course for the first time, all of the participants indicated that they would attempt to learn the content by themselves, either through books, the Internet, or other resources. However, they stated that if they struggled, they would seek out additional human resources, and how they chose to collaborate varied among the participants. As discussed in Chapter 12, Betty and Mary preferred to collaborate with their peers during lunch or after school at Site 1. Helen would seek out a “trusted” (Interview) peer from whom to request materials or to clarify her questions. Lucy wanted to observe others through floating or sitting in a peer’s class to observe the lesson before teaching it. Laura indicated that she viewed her students as a valuable resource for learning, and that she learned the content better by learning it with them. She asserted that they were a “learning community” (Interview). Likewise, Ed and Ellen indicated that they prefer to learn how to teach a new course through close-knit learning communities comprised of other teachers who were also teaching it for the first time. Who is missing from this list of collaborators? Administrators, department chairs, district personnel, professors, and professional learning facilitators are left out. Additionally,

when referring to facilitator-guided professional learning activities, the participants also found experienced mathematics teachers to be more credible than non-mathematics teachers. Simply, the participants preferred to learn with and from other mathematics teachers. This finding was supported by Rinaldi (2007) who found that teachers found other teachers to be the most credible facilitators or career-stage appropriate professional learning. In her 12-participant case study, she noted that 10 of 12 teachers found that facilitators with personal classroom experience were credible because they understood and sympathized with their educational contexts and the struggles of their students.

Confusion among professional learning terminologies. Another interesting finding of the study suggests that teachers have difficulty distinguishing between the terms of professional learning (PL) verses professional development (PD). Although my literature review outlined scholarly differences between the uses of the terms *professional development* and *professional learning* (Easton, 2008; Guskey, 2000), my participants struggled to make a distinction between these two terms. I included this question within the interview protocol to establish whether this type of scholarly literature had actually reached the participants in the study. I also wanted to clarify the participants' definitions of both phrases in order to establish a commonly understood language of professional learning (or development) so that my definition and their definition would not be confused during the data analysis process. It should also be noted that one of the articles from the Professional Learning Journal, which was given to each participant, introduced the differences between the two phrases. Even if they did completely detail their distinctions between the two terms during the interview, the participants were provided additional opportunities to express their

views after the interview through the PLJ Reflective notes sheets and the Professional Learning Discussion Board.

Distinguishing between professional development and professional learning was one of the most challenging exercises for the participants throughout the interview. After long pauses of thought, participants attempted to answer the question, skipped the question, or thoughtfully teased out the differences between the phrases by reflecting on the distinctions between the words *development* and *learning*. As they elaborated upon their answers, the differences between their perspectives were illuminated. For example, Betty thought that the professional learning was more "academic" (Interview) and related to intellectual growth, while she asserted that professional development pertained to the development of the entire educator and their professional characteristics. "Professional learning is when you are actually growing intellectually in your professional knowledge, the characteristics of teaching math" (Interview). She associated professional development with the development of "your being," such as an educator's demeanor, interactions with others, the decisions they make, classroom management skills, integrity, and modeling a love of learning for their students. Additionally, Betty wrote within one of her blog responses that professional learning was different from student learning in that just because "students are high performing doesn't mean a teacher is high performing." However, she failed to elaborate on the specific differences between the two.

When I asked Mary whether she thought there was a difference between PL and PD, she paused for about five seconds, looked up at the ceiling with her finger on her chin, and then responded, "I would say no because I'm not that deep" (Interview). Mary laughed and continued. "I can't think that way." After a few more seconds to think, she asserted that she

really thought they were the same thing. Mary's struggle to differentiate between the two phrases was also underscored by one of her entries within her PLJ. Within the margins of one of the articles in which the author proposed the differences between PL and PD, Mary highlighted an entire column, and wrote on the bottom of the page, "I'm sorry. I still don't know…" (PLJ entry).

Explicating the differences between PL and PD was also an interesting exercise for Lucy. When she first responded to the question during her interview, she attempted to piece together her definition based on how she interpreted the words *learning* and *development*.

> You're learning something that's new or developing some kind of knowledge. And professional, I just think of either content or how to, I mean, (pauses) development? Well, learning… Now that you made me think about it. Gosh! Development I say you are just honing on, er, not honing. I don't know another word for development. But, I feel like learning is new to you, and developing is—*crafting*. If it's developing, it's like a constant thing. But, development—No. I don't think, I've never thought about the difference until just now... It was like they were never compared… so I didn't think there's a difference. I just felt it was the same thing. (Interview)

During the interview, she answered my question with a question. While thinking aloud that professional development was "on your own" (Interview), she then asked whether professional learning was how her state defined Professional Learning Units (PLUs). I then told her what "PLU" stood for, and she asserted, "And professional development is… on your own... but maybe not necessarily on your own, but not like a PLU. That's just what hit my brain, but I'm still like, I don't know." Later, in a blog entry on the Professional Learning Discussion Board, Lucy wrote, "I thought I described professional learning as a formal thing. I guess I was thinking strictly workshops or in-services that we're forced to go to." In contrast, she noted PL occurred during those informal moments when teachers caught each other in the hallway between classes and throughout the day.

Helen had a different perspective on the differences between PL and PD. Helen asserted that professional learning was part of the larger picture of professional development. However, when I asked her to clarify her thoughts, she stumbled a bit over the terminology.

> Professional learning is overall, and then you're developing… You know, lifelong learner. So it's continuous… that's continuous. The development—there are stages. That's what I look at it more like—in stages. (Interview)

She also felt that the process of professional learning should be embedded within an educator's career. She explained that educators "should all be lifelong learners." To Helen, that entailed imparting knowledge to students, modeling learning, and constantly evolving their instructional practices. She believed that teachers who did not evolve in their practices and their pedagogy ultimately became "stale and dead."

Among all the participants' responses to this question, Laura's response surprised me the most. Up to a certain point in the interview, she elaborated on various details of her photographs and her perspectives of learning. However, when I asked her what she thought the differences were between professional learning and professional development, or whether she thought there were any differences at all, she paused to think. At first she was willing to reflect about the differences in terminology. Then she just decided not to answer.

> You know, I'd have to really think about that one longer. I would tend to say no. (Whispers to self) Professional learning and professional development. Well, PLUs. PDUs! (Laughs)… I would tend to say no, but if there is, it's probably something I'm not aware of. (Interview)

After repeating the question to herself, she stated that she did not know. Then she asked, "Do I *have* to answer?" When I told her she did not, she responded that she just did not know. Then she asserted, "I don't have an opinion one way or the other."

Ed was a little more willing to think through the question. Yet, his 10-second pause made me think that he was challenged by the question. He finally suggested that there were subtle differences with a lot of overlap.

> I don't know how to put this into words. Learning is—whether professional or amateur learning—learning is learning. You need to be, um, trying new things, being exposed to new things, being forced to stretch… out of your comfort zone. It doesn't have to be elaborate. But, you know, you learn by not doing the same things you always do. So in order for it to be PL, it has to be relevant to your profession. (Interview)

He was emphatic that teachers professionally learn by putting themselves in uncomfortable learning contexts, and that they sometimes resist the process. He compared this process to coaxing students into learning a new method for solving systems of equations. He stated that at first his students resisted the process because they already knew another method that worked every time. However, the new method provided a different perspective of the problem-solving process, and some students learned to appreciate the usefulness of having a different process. Likewise, Ed felt that teachers needed to expose themselves to new ideas in order to potentially expand their content knowledge or instructional methods. He posed that the difference between development and learning was related to whether "it's imposed from above or whether it's embedded" (Interview). Ed elaborated that learning is more embedded and self-motivated from a teacher's standpoint. PD, on the other hand, was imposed on the learner by those in a position of authority who wanted evidence that teachers within that community were improving. He described "outsiders" as those who checked off boxes on a list to make it appear that teachers were learning when, in actuality, "it does not necessarily guarantee that learning occurred" (Interview).

Lastly, when I asked the same question of Ellen about the distinctions between PL and PD during her interview, she dissected the very nature of learning and professionalism. At first, she admitted that she noticed that it was in the PLJ, but that she did not get "that far" in the article. Then, she talked and reasoned her way through the question. She was also challenged by idea and paused a great deal as she thought it through. After restating the question, she asserted that professional development is something that teachers should do so that they may develop professionally. She pointed out that "development" implied growth across multiple areas, "learning" embodies attaining knowledge and that learning was different from development. What stymied her was thinking about whether different contexts for development and learning illuminated or clarified the differences between the two terms. Ellen reflected about these topics by describing different examples of development and learning.

> My muscles develop as I exercise them. Are they learning anything? Not necessarily. If I learned about bugs, does that necessarily mean that I've developed at all? Possibly, but in a different way. Now let's take them both professionally. If I've done professional learning, that means that I've probably obtained knowledge about the teaching profession, or learning, or education, or perhaps mathematics. All those would help me develop professionally, I would hope. Unless it's learning about something that I can't integrate. And that happens, doesn't it? So did I really learn anything? Did I really obtain knowledge? That's a good question too. Maybe. How do you assess it? Whether it was useful to you, in those instances? If I've been able to apply it since then. Whether I've been able to… whether it has answered a question for me, as far as how I need to teach something, or assess something, or, um, integrate that concept in. Maybe. Or I've been able to use it since. Did it make me grow as a person? Did it enhance my ability to do something in this classroom? But that's a tough sell, too, you know. It is, because it could be argued, probably, that some of these classes I took at some of these workshops weren't supposed to do that, but they did. (Interview)

Ultimately, she ended up raising more questions than drawing definitive conclusions. She stated that professional learning should be transferable into a teacher's profession.

Overall, she maintained that learning was linked to intellectual growth, while development consisted of moving from one type of development stage to the next.

All of the participants were caught off guard by this question. It was as if they were creating their own interpretation of each definition on the spot, and I was able to observe the extent to which the participants reflected, elaborated, and/or convinced themselves of the correctness of their answers. When presented with the ill-structured problem of differentiating between two seemingly similar expressions—professional learning and professional development—all of the participants paused for a few seconds to consider the question. Each participant's response provided evidence of his or her stage of reflective development (King & Kitchener, 1994). For example, Mary admitted that she had not given it much thought, and accredited her incomplete response to not being "that deep" (Interview). Her response provided evidence that Mary only perceived that there was a correct or incorrect response to the question, which embodies Stage 2 of the RJM (King & Kitchener, 1994). In contrast, other participants made more effort to tease out the differences between the vocabulary words *learning* and *development*. Laura, for example recognized that her district now quantified teacher learning through Professional Learning Units (PLUs), but that the units had been previously called Professional Development Units (PDUs.) However, after a short discussion of the differences, Laura just chose not to answer, stating that she did not have an opinion on the topic. Laura was less motivated to answer the question because she had not formed a personal opinion, and thus could provide evidence that she was within RJM's Stage 3 as "only [her] personal beliefs can be known" (p. 31). Other participants, such as Lucy, Helen, and Ellen, were more willing to admit that they did not know the answer, but also reflect about and generate some ideas with more persistence

and inquiry. For example, even though Lucy was willing to admit that she did not know the answer, she tried to answer the question twice during the interview and again on the blog. At the conclusion of her interview, when I asked her if she had any additional thoughts she wanted to share, Lucy responded, "Well, now I am wondering what professional learning and development—the difference is… It was like they were never compared so… I just felt it was the same thing. Now I'm wondering if it is" (Interview). Lucy recognized that her knowledge on the topic was uncertain, and she was willing to think about the differences on her own during the interview; therefore, this level of reflectivity mostly resembles the RJM's Stage 4 in which the "concept that knowledge is unknown in several specific cases leads to the abstract generalization that knowledge is uncertain" (p. 31). Ellen's response to the question revealed that she maintained a Stage 7 level of reflectivity because she was willing to go through an inquiry process to find general ideas that are consistent across many domains. This question prompting the participants to make a distinction between PL and PD was the only ill-structured question embedded within the interviews. Therefore, I acknowledge that there was not enough data to definitely support labeling each of the participants with one of the seven stages of RJM (King & Kitchener, 1994). However, I maintain that the participants' responses deepened the study's findings regarding their beliefs of professional learning while also supporting the other findings on the participants' intellectual development position or way of knowing. Moreover, the participants indicated that they had not considered the differences between PL and PD prior to the interview. Therefore, during the interviews both the participants and I used the phrases professional learning and professional development interchangeably.

Perspectives of professional learning through photography and images. Through the use of Photo Elicitation Interviews (PEI), I explored my participants' perspectives on professional learning through both their narratives and their photography. Their

explanations of the photographs sometimes surprised me. For instance, when I first viewed Mary's photograph of a clock, I falsely assumed that she was going to say that many aspects of professional learning were a waste of time. However, during the interview Mary revealed that the clock represented why learning should take place. Time, for her, is the agent that promotes change in the classroom. Therefore, she felt that other teachers should be motivated to learn in order to adapt to the evolving contexts of teaching mathematics.

As I developed my Professional Learning Profiles, I asked myself what type of professional learning questions the photographs were answering. Stepping back from each case to look at the broader story of the picture, I found that Betty's photographs explained *how* she wanted to learn. Lucy's images illustrated *what* she wanted to learn (i.e., technology and classroom management techniques). In contrast, Mary's photographs of technology captured not only *what* and *how* she wanted to learn, but in what ways she was supported throughout the process. Her clock photo represented why she was motivated to learn, while her roundtable photograph captured how she preferred to learn with her peers at her own school. Helen took three photographs (her desk with an empty chair, her cell phone, and various resources on her desk) each painfully documenting how she works in isolation. She explained that although she may be considered a "loner "(Interview) within her department, she still feels well-connected through resources on the Internet and by contacting her friends at other schools. "So, I'm not really in it alone" (Interview).

Laura stated that she took photographs of motivational posters to illustrate that teachers surround themselves with posters or quotes and ask, "Why do we do this? Why do we teach and why do we learn?" (Interview). She felt educators should be naturally motivated to regulate their own learning, but that they often resisted the process. Her other

photographs addressed a variety of her concerns. An array of calculators, for example, illustrated that teachers should evolve in their instructional practices to be able to learn how to use several different types of tools. Another photograph of a website demonstrated that one way that she learned was through online courses. She explained that her bookshelf photograph symbolized how she was sometimes overwhelmed by too many resources when she learned something new. Ed's photographs introduced more symbolism as he sought to make me think through and interpret his photographs. He took a picture of trophies to represent their school's high expectations for learning, and took a picture of the sky to represent that there should not be a limit on learning. Ellen, who opted to find images on the Internet, wanted to represent her philosophy of professional learning. As included in document descriptions, she felt that professional learning should fit the needs of the learner where they are within their particular stage of their career. She included her conference advertisement to illustrate both how she enjoys learning and what she prefers to learn.

Table 9
Summary of Participants' Definitions of Professional Learning and Professional Development

Participant	Professional Learning is…	Professional Development is…	Photographs Illustrated…
Betty	Intellectual growth	Development of your professional being	How she learns
Mary	No difference	No difference	Why she learns; What she wants to learn; How she want to learn.
Lucy	Learning something new	Crafting your profession	What she wants to learn
Helen	Part of professional development	Lifelong learning; Continuous learning in stages	How she learns
Laura	I don't know. I choose not to answer.	I don't know. I choose not to answer.	What motivates her to learn; How she learns; What she wants to learn
Ed	Trying new things; stepping out of your comfort zone; often embedded	Is imposed from above	How he learns; Why he learns; Philosophies of professional learning; Who he wants to learn from; Learning expectations
Ellen	Attaining professional knowledge	Growth across multiple categories	Where she learns; When she learns; Philosophies of professional learning

Addressing the Research Questions

The focus of this study was to explore the professional learning experience from the perspectives of mathematics teachers in high performing schools. The Professional Learning Profiles detail the participants' motivation to learn, learning goals, learning process preferences, and positive and negative learning experiences. The themes that were discussed illustrated commonalities or difference across these cases, and the relationships among the themes supported the development of the Professional Learning Sequence. In the following section, the research questions are answered based upon the findings.

The research questions were:

1) If a mathematics teacher in a high performing school pursues professional learning, why do they pursue professional learning?

2) If a mathematics teacher in a high performing school pursues professional learning, how do they pursue it and within what contexts do they pursue professional learning?
3) If a mathematics teacher in a high performing school has been exposed to professional learning, what influences that teacher to use or not use the strategies to which they were exposed?
4) If a mathematics teacher in a high performing school implements the strategies presented during some form of professional learning, how does he or she assess whether the strategy was successful?
5) How do mathematics teachers' beliefs influence their attitudes toward professional learning?

The participants' descriptions of their professional learning experiences were infused within the themes based in Educational Structures, Relevance, and Interactions with Others. These themes emerged within different stages of learning or across entire experiences among most or all of the participants.

1. If a mathematics teacher in a high performing school pursues professional learning, why do they pursue professional learning?

The first question relates to how the professional learning process is motivated or initiated. The findings indicate that either the learners chose to pursue professional learning independently, or an authority figure persuaded or mandated their participation. Within the context of this study, all of the participants were adapting to the state's curriculum reform. Some of the self-initiated learning experiences were related to planning for the new curriculum or learning to teach mathematics. Participants who tended to have more teacher-

centered perspectives of teaching and learning mathematics (Ernest, 1994) wanted to spend their professional learning time studying the sequencing of the curriculum so that they could see and be prepared for the new content. In contrast, Lucy, who had less teaching experience, was concerned about developing strategies for classroom management and organization. Helen, who found herself within more isolated educational contexts, pursued learning that helped her become more familiar with the mathematical content she was currently teaching. Laura, who had been teaching AP Calculus for several years, was comfortable with her content knowledge but concerned with how to motivate her students to buy into the process of learning. More broadly, Ed desired to learn about topics that were either related to mathematics or that were fun. He believed that it was okay to learn for himself. Finally, Ellen indicated that her learning interests had dramatically changed over time. Although she would have wanted to investigate disciplinary strategies as a young, early teacher, she was now more interested in technology and the over-arching effects of the new curriculum on student achievement. Specifically, Ellen uniquely stepped back from her present learning needs to notice how the trajectory of her learning needs changed over time. This reflection about her goal development over time provided a broader perspective of how all the learners defined their goals.

Dewey (1986) asserted that education should be evaluated by its effect on learners' motivation to continue to grow. Although these teachers had very different learning goals in mind for their own personal growth, state and local officials often developed goals independent from and omitting the perspectives of educators. By designing large professional learning opportunities for the "masses," but targeting no one in particular, the professional developers completely alienated the mathematics teachers in the study.

Frustrated, they felt that that their administrators or school district officials were disconnected from their learning needs, and they remained frustrated by learning goals that focused too much on general, subject-neutral instructional strategies and too little on the mathematics-specific content or pedagogy.

When the participants pursued some form of professional learning independently, their initial diagnosis of why they needed to learn easily justified the process. They believed in the process of learning while they developed their learning goals independently or with other teachers. In contrast, when a learning goal was designed for the learner by some outside authority figure, learners' justification of the relevance of the experience still had to be established. As the participants indicated, if they were mandated to attend a faculty meeting during which one strategy or idea was being presented to a large body of educators who did not share a common teaching area, the mathematics teachers in the present study became increasingly critical as to whether the strategy was transferable to a mathematics classroom. In cases of mandated sessions related to technology, teachers were equally frustrated when they did not have access to the tools or time to experiment with the technology themselves. Moreover, the participants primarily desired to learn about topics that were specifically transferable to the context of teaching mathematics.

2. **If a mathematics teacher in a high performing school pursues professional learning, how do they pursue it and within what contexts do they pursue professional learning?**

To a great extent, how participants pursued professional learning and their contexts for professional learning were determined by whether the teachers themselves developed their learning goals or whether an authority figure developed their learning goals for them.

This study's findings imply that mathematics teachers are more skeptical of mandated professional learning sessions, especially when the goals of these sessions are not clearly applicable to settings for teaching mathematics. In these cases, the participants attended the required sessions but were rarely engaged in a learning process. The teachers passively listened to facilitators, motivational speakers, or technology specialists as these presenters relayed information that many participants found unrelated to teaching mathematics. In these scenarios, the participants dismissed and rejected the strategy's implementation.

However, during professional learning sessions that focused on mathematical teaching strategies or tools, the participants reported being engaged in the learning process. Lucy, for example, received resources at her summer program, and worked collaboratively with other attendees to complete learning tasks from a student perspective. Likewise, Mary also completed spinner tasks at a similar professional learning session offered by her school district. In both cases, the participants went back to their classrooms and attempted to implement the strategies or activities with their students.

Most of these sessions took place after school or during teacher in-service days. The contexts for these professional learning situations included the fact that they were consistently held away from the participants' schools, such as at another school within the school district or a conference room near the state capitol, which was approximately an hour from the participants' schools. When teachers took part in the goal-setting process, they often became part of designing the contexts (i.e., when and where) their learning would take place. Based on how they balanced their time between personal and professional commitments, professional learning with peers would take place at their school during the school day (either during lunch or a common planning session), or outside of the school day

(either after school or during the summer). Additionally, teachers' preferences for where learning should take place broadened in proximity as their desire for different types of learning intensified.

Participants who were planning content with their peers felt that professional learning should be site-based. In contrast, teachers who had begun to collaboratively network with other teachers outside of their school for resources or professional insights were comfortable calling colleagues or conferring with them at school-neutral locations, such as restaurants or Math Team competitions. The proximity of the teachers to their school during the learning process broadened as the participants voluntarily sought out additional people and resources to address their learning goals. Although some participants were content and even desired site-based professional learning, other participants voluntarily sought out learning opportunities outside of their school, school district or even state.

3. **If a mathematics teacher in a high performing school has been exposed to professional learning, what influences that teacher to use or not use the strategies to which they were exposed?**

The findings from this study suggest that teachers were more likely and willing to implement strategies when they feel that the purpose of the strategy was applicable to their practice or content area. When they could not clearly connect the purpose of the strategy to their teaching practices or content area, they simply rejected the strategy and did not use it. Participants also rejected strategies or professional learning content when technology resources or software programs discussed during in-services were not available at their particular school. The unequal accessibility to district resources frustrated the participants,

and made them feel that those conducting the sessions did not understand their educational contexts. Teachers were more likely to implement strategies from professional learning experiences for which they had a role in developing the learning goals.

4. **If a mathematics teacher in a high performing school implements the strategies presented during some form of professional learning, how does he or she assess whether the strategy was successful?**

Although the teachers in the study provided detailed descriptions of their learning processes, they often fell short in their evaluation of a new knowledge or skill. They assessed the learning experience when they initially considered engaging themselves in the learning process. Conversely, the participants differed in how (or if) they evaluated what they learned after implementing the strategy or content.

Participants who planned together, like Betty and Mary, implied that they used their plans, but they did not explain how they evaluated the effectiveness of collaboration. The goal of planning was to prepare. The assessment of being prepared to teach was inconsequential. Implementing and assessing classroom management techniques was slightly less ambiguous. For example, when Lucy implemented strategies that she learned from a state-mandated workshop on implementing instructional practices for a new course, she tried the suggested strategies for an extended period of time. However, she stopped using the strategies after receiving feedback from her students, and she considered whether the strategies were meeting her students' learning needs. She noted that because her students struggled to attend school consistently, a project-based curriculum was more difficult for her to implement and for her students to master.

Participants who implemented strategies related to technological tools noted that they assessed the effectiveness of their learning via their ability to use the tool for its intended purpose and within the context their desired application. Betty said that she evaluated the effectiveness of the technology learning experiences by whether she was "able to do it" (Follow-Up Interview). Similarly, Ellen explained that her online class on Access did not meet her needs. "And I needed a teacher who knew more about macros than I did to help me iron out some bugs, and I didn't have that. And so, I had a real bad impression then of what online learning was" (Interview). Because her online class was not successful, she "got some students to help" (Interview) her, and together they were able to get her database to work. Ellen also believed that her experience of learning to use the calculators with Ed was a positive experience because they were able to figure out the functions of the tools together. Participants also indicated that technology-focused learning opportunities were unsuccessful when they did not have the access or time to use the tool. Betty described the one-hour demonstration on Geometer's Sketchpad as "a waste of time" because she was not allowed to "sit down at the computer and actually develop" (Interview) materials for herself. Laura was inspired by a workshop to use the promoted technology in her classroom, but did not have access to it. She described the experience as "good and frustrating" because she believed her school district only provided "this little bit, but they won't really give us all of it" (Interview). Therefore, they could not integrate this into their practices. In most cases, the teachers developed their own particular goal for using the technology. When the participants had access to and a purpose for their desired technology tool, then they assessed their learning experience by whether they could use the tool effectively. If they could use it,

then it was considered a successful learning experience. They did not, however, assess the extent to which using the new technology impacted their students' learning of mathematics.

In contrast, there was evidence that teachers used student feedback and student performance to assess creative or task-based activities. Lucy indicated that she sought feedback from her students after she implemented instructional strategies suggested at a state-provided workshop. "I'll always ask for kids' feedback. They'll let me know" (Interview). Mary liked the spinner task she implemented because she felt that her students learned about the difference between theoretical and experimental probabilities through the activity. She observed that her students started to think of real-world statistics as experimental. When I asked her whether she thought it was successful, she responded, "Well, I feel like I gave them the opportunity to see the difference between those two, but at the same time it's very time-consuming… I think it was worth putting in there for the ones could get it" (Interview). Likewise, Helen asserted that the trigonometric parent graph activity was successful because her students indicated that they understood how the graphs were developed.

As I reviewed the participants' accounts of how they evaluated their professional learning experiences, it became obvious that something was missing—their students. Their photographs captured what, how, and where they wanted to learn. Their narratives of professional learning also focused on how they wanted to learn and some of the barriers they faced within their schools. However, in most cases, when I asked the participants how they knew whether the learning experience was successful, they rarely linked their learning experiences with the learning experiences of their students. In the examples mentioned above, Lucy got a "vibe" (Interview) as to whether the strategy worked. Helen and Mary

both indicated that they inferred that their students had “understood” (Helen’s Interview) certain mathematical connections, but they did not explicate how they assessed their students’ knowledge.

Ellen was the only participant to directly link the success of her learning experience to student data. In describing the implementation of her geometry box project, Ellen indicated that her students benefited from project because she could assess their mathematical knowledge on geometric shapes by the product(s) of their work. She liked that the project allowed her students to be “expressive” and “let me know what they understood” (Interview) the properties of different shapes. “So for three years, we built boxes in geometry… It was a cool project, and they loved it” (Interview).

Other participants also expressed that their students engaged in meaningful tasks or projects. For example, Helen indicated that her students enjoyed the parent graph activity in which they collaborated to create parent graphs of trigonometric functions with strips of paper. She felt it was successful because her students commented that they liked the activity. She also felt that they understood the concepts. Mary also implemented the statistics spinner task with her students, and believed it to be effective in purpose, but practically, too long in length. In these examples, in which teachers assessed the usefulness of implemented activities, they turned to their students and their products to help them determine if the activity was worthwhile. The participants could not articulate how such activities or artifacts specifically helped them to assess their students learning. The participants who used student-centered activities or creative projects noted that they liked the activities either because their students maintained affective views of the tasks or projects or because they, as the educators, could form an impression of their students’ mathematical understanding from

the artifacts. However, the participants who used and discussed these activities did not describe how they used or gathered actual student data from the task or project.

5. How do mathematics teachers' beliefs influence their attitudes toward professional learning?

My theoretical framework, including Belenky et al.'s (1986) Women's Ways of Knowing (WWK), Hurtado's (1996) WWK extension stage of subjugated knowing, and Perry's (1968, 1999) positions of intellectual development, guided me as I explored how the participants learned, acknowledged authority figures, and voiced their perspectives with others. Additionally, Ernest's (1994) framework for educational ideologies also allowed me better determine which stances (if any) were applicable to the participants' perspectives of teaching and learning mathematics. The five ideologies include the industrial trainer, the technological pragmatist, old humanist, progressive educator, and public educator as described within my theoretical framework. Although each of the participants may not have fit squarely within any one particular intellectual position or educational ideology, I did find evidence of dominant perspectives of learning and mathematics. Goldberger, Tarule, Clinchy, and Belenky (1996) asserted that development pertains to acquiring more powerful ways of thinking, not just acquiring new information or behaviors. The authors explained that the positions or stages are not meant to "pin the individual rigidly into a category but to locate him/her with reference to a sequence, providing a way to conceptualize where the student is and in what direction he or she might be ready to move" (p. 40). Therefore, the explanations of the participants' beliefs towards learning, and learning and teaching mathematics are meant to provide evidence for the positions that they seem to dominantly

hold. A summary of the participants' logit scores from the initial beliefs survey and their dominant learning positions is presented in Table 10.

Table 10
Summary of Participants' Dominant Ways of Knowing and Educational Ideologies

	Betty	Mary	Helen	Lucy	Laura	Ed	Ellen
Logit Score	-.66	-.31	-.1	.27	1.44	1.58	2.84
Way of Knowing	Subjective Knowing and Received Knowing	Received Knowing	Subjugated Knowing	Received Knowing and Subjective Knowing	Procedural Knowing	Relativism Position	Constructed Knowing
Educational Ideology	Industrial Trainer	Technological Pragmatist	Old Humanist	Not enough information	Technological Pragmatist and Old Humanist	Progressive Educator	Progressive Educator

Within the context of professional learning, the participants' positions of their own learning with respect to their educational contexts reveal the educational lens from which they interpret their experiences. What do these perspectives reveal about teachers' learning goals, learning process, and their evaluation of their learning experiences?

First, the findings suggest that the initial survey instrument was an effective tool during the participant selection process. Participants who scored lower logit scores demonstrated that their beliefs towards teaching and learning were more teacher-centered than those who had higher logit scores on the initial survey. For example, Betty, whose logit score was -.66, demonstrated that she agreed with several elements of the industrial trainer. In contrast, Ellen's dominant progressive educator ideology maintained more student-centered approaches to teaching and learning mathematics, and Ellen earned a higher logit score of 2.84. Comparing the participants' logit scores to their educational ideology suggests that participants with lower logit scores demonstrated evidence through their stories of professional learning that they held more teacher-centered perspectives of teaching and learning mathematics compared to those participants who had higher logit scores.

Comparing the seven participants in this study, as the logit scores increased, the perspectives of teaching and learning gradually changed from the perspectives of the industrial trainer to technology pragmatist to old humanist and finally to the progressive educator. Recall that the industrial trainer believes mathematics to be fixed set of truths and rules in which students of fixed abilities learn through hard work, effort, and practice. The industrial trainer believes that mathematics is a useful body of knowledge by which the educator uses hands-on activities and technology to teach mathematics through skill acquisition and real-world experiences. In contrast, teachers possessing the old humanist perspective believe mathematics is structured and pure and teachers should explain and motivate their students to understand and apply mathematics. Old humanists also perceive society as elitist and class stratified. Finally, the progressive educator views mathematics as process-oriented to be personalized to the learner. Progressive educators assert that students learn mathematics though exploration and play, and those activities that help students avoid failure are critical. Therefore, we can see that as participants scores increased along the logit continuum, their perspectives of mathematics went from a fixed perspective to a process-oriented perspective. Their beliefs of teaching mathematics changed from learning mathematics through hard work and practice to learning mathematics through problem-solving, explorations, and creative play.

Similarly, the participants' logit scores were also related to their most dominant intellectual development stage. As the participants' logit increased, their way of knowing went from accepting truth from others to looking to themselves for truth to then considering multiple avenues of resources in order to construct truth for themselves. For instance, Mary's stance on learning most resembled that of a received knower. If she wanted to learn

about technology, she sought out someone else who knew more about the tool to show her how to use it. She did not indicate that she tried to figure the tool out for herself. Mary received what she knew about technology from others, and thus she was frustrated when her school district provided technology resources without "training" (Interview) her how to use it. In contrast, Ed who took a relativist (Perry, 1968, 1999) stance toward learning, wanted to problem-solve in order to learn. He explained this using the example of learning how to use a calculator. He would want to figure as much out about it by himself prior to seeking out help from others. After determining that he needed help, he would seek out a peer who could scaffold the process without just giving him the answer. He explained that he needed to "do it" (Interview) in order to learn it. The exception to this progressive relationship between increased logit scores and more developed ways of knowing was Helen. Her logit score lies between the scores of Mary, a received knower, and Lucy, who exhibited both received knowing and subjective knowing. Hurtado (1996) claimed that her sixth scheme of *subjugated knowledge* distinguishes knowledge as "temporarily suspended or subjugated to resist structures of oppression and to create interstices of rebellion and potential revolution. It is often referred to as a 'border consciousness'" (p. 386). Helen's political perspective of her world and her relationships with students' parents and administration illustrated that she recognized her voice as a learner and knowledge creator; however, she described her relationships with her students, administrators, parents, and some colleagues as if she felt she had to defend actions, guard her words, or isolate herself professionally, only seeking help from "trusted colleagues" (Blog Entry).

The participants' intellectual development positions and educational ideologies also provided insight into their views of expert teachers, their preferred method of professional

learning, how they interacted with their peers, what resources they used while learning, and even where they learned. The following figure is summarizes how the participants' intellectual development, educational ideology, and perspectives towards professional learning characteristics changed as the logit increased.

As participants' beliefs became more student-centered, their perspective of expert mathematics teachers changed from knowing the entire curriculum to being able to being to problem-solve and adapt in multiple contexts. As the participants' logit scores increased, their views of where learning should take place expanded from their school, to their school district, and finally to the boundaries of their state and county. Likewise, their visions of with whom they could learn also expanded from peers at their school to peers at other schools and finally dynamic learning communities.

Although this perspective seems irrelevant to the larger topic of professional learning, how Lucy responded to others' expectations of her is indicative of how she copes with imposed professional learning. She went along with what others suggested. Lucy sponsors two clubs, and is an assistant coach for two different sports. What motivates her to be so involved? It is expected of her by others. Similarly, she attends mandated professional learning sessions with little complaint ("They're not so bad" (Interview)), only to later feel that her time was wasted.

A teacher's way of knowing and educational ideology was also related to how they assessed their learning experiences. If teachers get to the point of adapting the new skills or knowledge for use in their classrooms, they may assess its success without asking why, how, or to what degree was it successful. The participants' beliefs toward teaching and learning provided a lens through which I interpreted the participants' assessment practices.

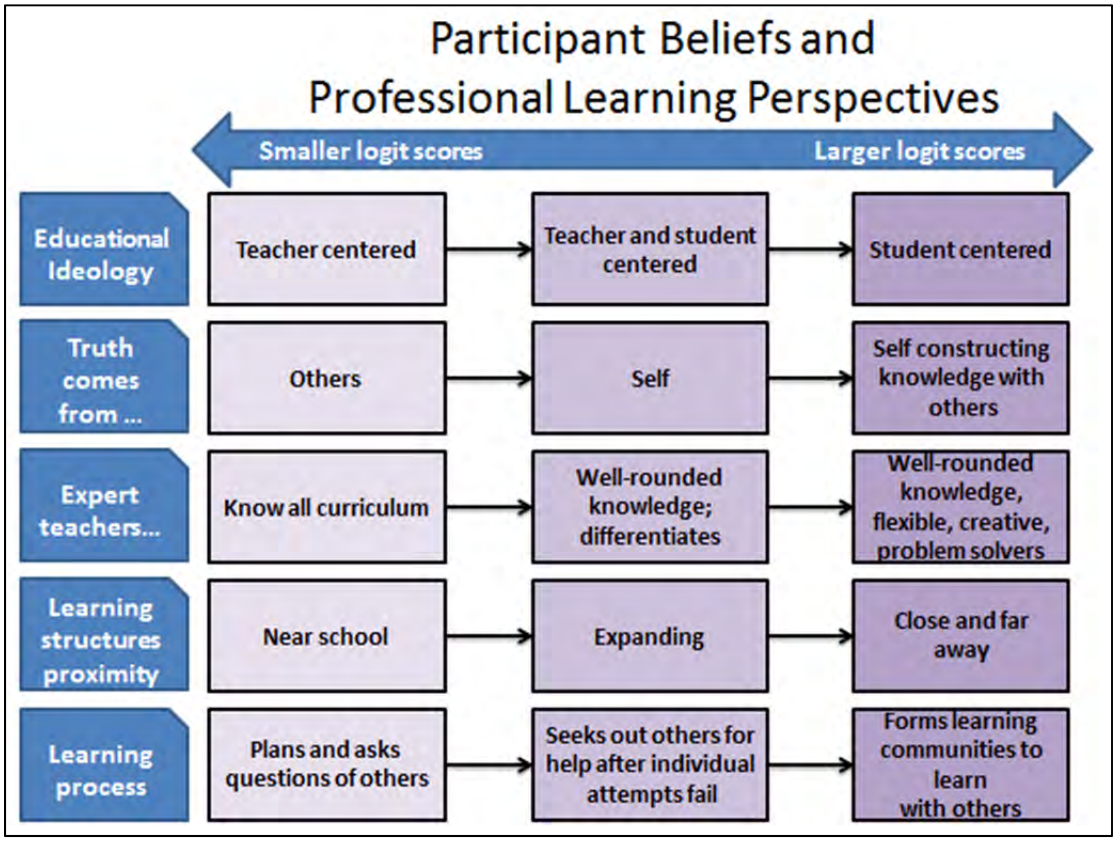

Figure 55. Participant Beliefs and Professional Learning Perspectives

For example, Betty, who had a more teacher-centered philosophy of teaching mathematics, assessed her learning as to whether it "worked" (Follow-up interview) or whether it correctly solved her problem. If it did not work, she deemed it unsuccessful. In contrast, both Ed and Ellen, who had a more student-centered philosophy of mathematics, found value in student activities even when the activities were not implemented perfectly. Both of these participants listened to their students' feedback to find some value in the implementation while still trying to *improve* on the process. When teachers were left to implement learning strategies independently, they also assessed these experiences independently. Professional developers would likely find it productive to provide more support and scaffolding to help teachers evaluate their own learning, not just after a session is complete, but after teachers apply their learning to their educational contexts.

Additionally, professional developers could encourage teachers to assess their learning by looking for degrees of educational value, not just whether "it worked." Finding increments of value in the learning processes may motivate teachers to commit to learning processes more quickly or seek to improve upon strategies that met some, but not all, of their needs.

Limitations

Although some limitations were out of my control during the development of and implementation of this study, it is necessary to present these limitations in order to avoid misinterpretations of my findings (Creswell, 1998; Lunenburg & Irby, 2008).

Participant Selection

The participants' perspectives towards teaching and learning were varied. Although I am satisfied that the sample included teachers who possessed different perspectives of professional learning, there may have been some perspectives that were inadvertently left out, such as teachers who had a more balanced-perspective of teaching and learning mathematics. Other unrepresented perspectives may also include male mathematics teachers, mathematics teachers of various ethnicities or races, or even mathematics teachers who are more heavily involved in activities outside of school.

Additionally, determining the participants' educational ideology was difficult because some participants described their learning experiences as a disjointed experience from teaching their students. I found that my participants who, based on the initial beliefs survey, maintained more teacher-centered beliefs of teaching and learning were less likely to discuss their professional learning experiences with respect to their students. In contrast, those who provided responses that agreed with more student-centered practices were more likely to connect their learning to learning experiences within their classroom. In terms of

data, it was more difficult to justify a participant's educational ideology for participants whom I suspected had more teacher-centered practices because they rarely talked about their students or their classroom philosophy. Likewise, teachers with less experience, such as Lucy, provided fewer examples connecting professional learning to their teaching experiences than other participants who had over 30 years of teaching experience, such as Ed or Ellen. One way this limitation may be addressed in future research is to simply include more probing questions regarding the participants' instructional practices and how they view their students as learners.

Time

With the given timeline for the study (see Appendix E), I collected most of the data, such as interviews, blog entries, and PLJs towards the end of the spring semester. As Laura pointed out, I did not conduct the study during the "honeymoon" (Interview) period of the school year. She implied that her perspectives likely change throughout the year. Therefore, conducting this study over a full school year, allowing more time to conduct interviews at the beginning and end of the school year may have yielded different responses from the participants.

Enthusiasm

Initially, online responses were rich, descriptive, and to some extent, more thoughtful than those at the end. By the end of the study, teachers appeared to be less invested in the process. It is possible that the teachers were overwhelmed with the other responsibilities of their profession that occur toward the end of the semester (e.g., standardized and benchmark testing, Advance Placement testing, or preparing to give final exams). I could have checked for lack of enthusiasm by giving them additional time during

the summer to complete the Professional Learning Discussion Board blog entries as well as the PLJs.

Variety of Resources

Some of the participants did not complete the Reflective Learning Journals or post responses on the Professional Learning Discussion Board. Although I was ultimately able to gather enough data about these particular participants from their interviews, photographs, and supplemental materials, lack of these data sources with other participants could have undermined the triangulation process. By asking for their participation, I was asking them to communicate their reflections through a variety of media. My findings reveal that Ellen, one of the participants who did not post blog responses on the Professional Learning Discussion Board, did not like online learning. Therefore, I failed to recognize how her learning preferences influenced her motivation to participate in certain aspects of the study. To address this issue in future research, I would give participants a choice in the activities that they wanted to complete. Therefore, if participants, like Ellen who did not like online learning, were opposed to providing blog entries, perhaps they could have the option to provide their responses in alternative ways such as via interviews, conference calls, emails, or simply by giving the participants a hard copy of the prompts and asking them to record their responses. The technical difficulties of signing on to the blog could have become barrier for her to participate. Other creative outlets for the participants to express their perspectives should also be considered.

Implications and Recommendations

Implications for Future Research

The findings of this study supply evidence that teachers need professional learning to be differentiated across the domains of time, interactions with others, content, and learning structures. Ellen pointed out that her learning goals changed as she progressed within different stages of her career. During the time of the study, she placed more emphasis on fostering the Process Standards for mathematics (NCTM, 2000) (i.e., problem-solving, reasoning and proof, communications, connections, and representations) into her pedagogy than in her previous goals of technology integration or discipline. Farmer, Hauk, and Neumann (2005) asserted that in order for teachers to change their practices from teacher-centered pedagogy to those that emphasize the Process Standards, teachers may first have to develop new beliefs, pedagogical habits, and professional dispositions. Additional research could extend this study to explore the critical moments and learning experiences that contribute to how and why educators change from one ideology of teaching mathematics to another.

Ball and Forzani (2010) asserted that that although teachers desire to completely understand the content they teach, knowing what to teach and knowing how to teach the content are two completely different ideas. Although several of the participants in this study suggested that expert teachers know their subject well, only a few participants noted *how* the expert teachers knew their content. Hill, Rowan, and Ball (2005) found that teachers' Mathematical Knowledge for Teaching was a positive indicator for student achievement, yet the researchers still know very little about the nature of this knowledge. Furthermore, they suggested that content-specific professional learning will positively influence students'

achievement. Therefore, additional research should be conducted to explore how secondary mathematics teachers' content knowledge is related to students' content knowledge. Specifically, if teachers in high performing schools teach students who are mathematically successful, how is teachers' content knowledge related to their students' content knowledge or problem-solving skills?

Mary and Ellen both admired teachers who understood how their subject connected with previous and future classes and topics, and they could see multiple pathways for problem solving. Ellen specifically connected this expert knowledge to the ability of facilitating classroom discussions as students seemingly veered off course to explore other topics. She pointed out during her interview that expert mathematics teachers had the foresight to know whether the journey was worth the instructional time. Ball and Forzani (2010) suggested that specific professional practices related to professional preparation are rarely assessed. Asserting that researchers know little about the pedagogy of teachers, they suggest that researchers should further investigate how to empower teachers to not only learn mathematical content, but also to learn it dynamically enough to unpack a curriculum and lead their students into problem-solving activities. Thus, further research should investigate the relationship between teachers' learning processes and the instructional practices that they use within their classroom.

I maintain that the findings of this case study provide detailed, rich descriptions of mathematics teachers having different perspectives of learning and possessing various learning styles; however, even with seven cases, there are many other perspectives waiting to be explored. Do teachers who desire collaboration, personalized goals, and engaging professional learning implement these concepts into their classrooms? Additional research

should focus on developing additional case studies of teachers within different educational contexts, curriculum settings, and cultural backgrounds. For example, how would the perspectives of teachers in low-performing schools differ from those described in the present study? Would teachers of color learn in isolation if they were part of a more diverse faculty? How do the power relationships between teachers, parents, and administrators in average or low-performing schools influence how mathematics teachers professionally learn? Researchers should consider extending this study to different educational settings and include mathematics teachers from elementary, middle schools, or higher education.

One aspect of the interview dialogue revolved around having the participants describe how they would learn how to teach a new subject for the very first time. Although the findings suggest that the participants relied on textbooks to become familiar with their content as well as their peers for additional support in providing resources or filling in content knowledge gaps, further research could extend this question to investigate how teachers grow in their practice once they feel confident in their content knowledge. For example, how do teachers teach their content for the fifth time and in what ways are the practices they currently use different from those they used in the past? Further research could narrow the study's sample to include only teachers who had been teaching the same course for several years, and then explore how these teachers describe their professional learning. Does these teachers' professional learning flourish or cease when their content area is fixed? Furthermore, inviting seasoned, experienced teachers to discuss their professional growth in these areas could also showcase how, whether, and to what extent subtle advances to deepening content knowledge develop while teaching one content area for a long period of time.

Implications for Practice

This study provided several different perspectives of professional learning by seven very different mathematics teachers. Imagine for a moment: all of the participants are sitting in a conference room, waiting for a professional learning session to begin. What would all of these teachers find beneficial? How could a professional developer, facilitator, or mathematics educator win over this skeptical audience so that they all ultimately gained something they could later transfer into their practices? One of the findings from this study suggests that although all these teachers may want to take part in the goal-setting process, their goals and ways of learning are as unique as their personalities and perspectives.

The teachers' learning goals, learning process preferences, and preferred professional learning structures were also unique. Trotter (2006) suggested that teachers should have the opportunity to form their own teaching goals. The findings from the present study also suggest that teachers want more control of when, where, and with whom they learn. Teachers prioritize their personal and professional time in different ways. As Ed and Laura both pointed out, some teachers work late and other teachers leave early. Additionally, the participants believed comparisons between teachers who left early with those who left late would reveal differences in their willingness to collaborate or distinctions in when they wanted to professionally learn. Although these claims were not verified, the teachers in this study illustrated that their different work schedules did influence when they could learn and with whom they could learn. Professional developers, administrators, and department chairs should be mindful of the preferred times teachers choose to work with their peers. As a professional developer, it is difficult design to a learning session that meets the needs of both groups within two very different time constraints. Therefore, professional

developers should consider providing teachers more options for when they would prefer to learn and seek schedule solutions that are available with their schools or school districts. Dearman and Alber (2005) make several suggestions for helping teachers make and take the time to collaborate. Administrators could group teachers by their free periods, or using a once a week flexible school schedule in which the school day started 30 minutes later and teachers arrived 30 minutes earlier in order to have one hour of planning together. The authors' suggestions also suggest include allocating state, federal, and local funds to "buy time" for teachers to work together (Dearman & Alber, 2005). Additionally, department chairs and administrators could also consider the mathematics teachers' philosophy of time management as subject area teams are developed. If a group of three mathematics teachers who prefer to work late are all on the same subject area team, each member is less likely to resist having after school subject area teams. Pairing or grouping teachers who leave earlier may also create subject area teams who manage their time and respect their time equally.

Even though all teachers have mundane aspects of their profession in which they must be trained (i.e., technology, proctoring tests, or district-wide professional policies), most of these participants sought opportunities that helped them grow specifically as mathematics teachers. The participants' differing perspectives toward professional learning were shaped by their beliefs, self-defined needs, goals, and their personal and professional priorities. Although one-size-fits-all professional learning sessions may be the easiest, most cost-effective means of training entire faculties to become familiar with school or system-wide policies, skill sets, or procedures, general and ambiguous professional learning sessions are far less effective at motivating and encouraging mathematics teachers to learn.

Trotter (2006) asserted that adult learners need self-directed learning that takes into account that individual differences increase with age. Additionally, adult learners use experience as a resource, need opportunities to create their own learning goals, and learn through reflection and inquiry (Trotter, 2006). In spite of their different perspectives of professional learning, each participant echoed the sentiment of their own students as they attended mandated professional learning sessions: When I am ever going to use this? If teachers could clearly see the connections of professional learning goals to teaching mathematics, they were far more likely to attempt to implement the strategy.

Once teachers have become part of the goal-setting process, professional learning experiences could be designed to engage teachers in challenging learning activities that require teachers to search, evaluate, construct, create, or organize learning materials into resources or ideas they can transfer into their practice (Wlodkowski, 2003). How teachers are engaged and with whom they are engaged should be carefully considered. The results of the study imply that teachers are more likely to create new knowledge when they are working with other teachers with whom they feel they can be educationally vulnerable while engaged in the learning process. Wlodkowski (2003) asserted that teachers benefit from working with those with whom they perceive they have something in common.

> Whenever participants witness people similar to themselves (in age, gender, ethnicity, class and so on) competently perform the desired professional [learning] goal, their self-confidence is heightened, because they are prone to believe that they too possess the capability to master such activities. (p. 43)

Grouping teachers by common subject areas, common career stages, or even by common learning communities could establish a common ground within large group settings to help teachers feel that they connect with the facilitator and those with whom they are expected to collaborate throughout the experience. Members of collaborative groups or

pairings may need to have more in common beyond a common learning goal if they are going to feel comfortable to asking for help and constructing knowledge with others. Grouping teachers by level of experience or content knowledge may allow teachers to feel more comfortable to create knowledge with their peers. Dearman and Alber (2005) asserted that "rather than taking a one-size-fits-all approach" (p. 636) to educational change, teachers and administrators should make time to work together in order to improve teaching skills and classroom practices to meet diverse learners' needs and improve student achievement.

Additionally, the findings reveal that teachers value administrators and department chairs as key players in their learning. Although the participants did not necessarily learn *from* these educational leaders, they relied on these leaders to provide the learning structures and support systems (Wlodkowski, 2003), like common planning, to help them utilize their time more effectively. Ironically, Site 1 mandated common assessments, while not providing a common planning period, and Site 2 did not require teachers to have common assessments but did provide common planning. The necessity at Site 1 for common planning originated from a departmental mandate that everyone on the teaching team had to be, instructionally and mathematically, in agreement. Site 1 participants did not describe their subject-area group members as withdrawn members or choosing to work independently. However, Site 2's teachers did not utilize the time given to them to collaborate, were not mandated to use common assessments and curricular pacing charts, and did complain that some department members were not team players. In this environment, independent learners were more tolerated, yet they were also professionally judged. Therefore, although common goals may be established through smaller, close-knit teaching groups, the overall identity of the department was disconnected through disjointed subject area teams and different

perspectives of time management for collaboration. However, the participants expected administrators to provide a time and place for collaboration within both contexts.

Department chairs were influential in pointing teachers towards learning goals without actually mandating their attendance. Therefore, administrators should also connect with the needs of mathematics teachers (and other faculty members) to determine practical ways to support teachers through scheduling, teacher workdays, teaching assignments, and through the development of collaborative teams. Department chairs play very special roles within this learning sequence. Through their position as both leaders and educators, they have the ability to voice their department's concerns to administration. Department chairs also are well-positioned to become more knowledgeable about the learning goals and needs of the teachers within the department by observing teachers' lessons and engaging them in non-threatening conversations about content and pedagogy during times when teachers are available. As both teachers and educational leaders, department chairs should attempt to balance pressuring teachers to grow with supporting teachers through the process (Wlodkowski, 2003). Teachers in this study indicated that their department chairs took the time to ask them about their learning goals or to posit personalized professional learning suggestions for each member of the department. As department chairs demonstrate thoughtfulness and care when expressing suggestions for teachers' professional growth, teachers may be more inclined to reveal vulnerabilities, ask for help, or voice concerns as they adapt to curriculum changes.

Final Thoughts and Reflections

The educational backdrop of curriculum reform provided fertile ground for establishing a context for teachers to professionally learn, improve their practices, or grow.

Although states integrate curriculum reforms, professional learning offered by school districts should promote “a coherent system of instructional materials and comprehensive teacher training” that allow teachers to plan for and adapt to changing curriculum (Ball & Forzani, 2010, p. 12). In order to do that, school districts serving diverse learning communities should consider including more content-related professional learning goals to meet the specific needs of mathematics teachers. Hill and Ball (2004) asserted that content-centered professional learning improves student achievement, and teachers who are in the lowest third of the distribution of mathematical knowledge have the most to gain from such professional learning. The authors go on to suggest incentives and differentiated instruction to meet the needs of these teachers; yet my findings suggest structural obstacles of time and space should also be addressed. In contrast, Farmer et al. (2005) suggested teachers’ dependency to master mathematical content was an obstacle to implementing Process Standards.

Universities and institutes that offer graduate classes for practicing teachers should also recognize that practicing teachers need differentiated and dynamic instruction. Ball and Forzani (2010) asserted that most professional learning “remains a collection of uncoordinated, knowledge-centered courses… Specific professional practices—such as conducting effective class discussions or accurately diagnosing a child’s reading difficulty—are rarely assessed” (p. 11). Mathematics teachers who pursue graduate courses also desire experiences and interactions with their peers. However, Ed and Ellen commented that their graduate learning experiences were not meaningful because the college professors were not in their specific classrooms or contexts, and the content of the college courses was repetitive to courses they had taken in their Master’s program. Although Ellen and Ed began

a graduate program together, they left the program once they concluded that the content of the course did not offer challenging and new content to meet their professional needs. Although I, too, have experienced graduate courses that presented material that I had learned in other classes, the most valuable learning opportunity that I have experienced began with the journey of conducting this study. Specifically, I learned so much more about my profession and about professional learning through the stories of my participants. Their experiences, their stories, and their wisdom have opened my eyes to how differently mathematics teachers learn to teach mathematics. In essence, I valued my participants' educational wisdom because I connected with and to their stories. Likewise, the teachers in this study desired to learn with and from teachers with whom they connected (Rinaldi, 2007). However, conducting research and attending graduate classes are two incredibly different experiences. Therefore, I suggest that the graduate courses include more self-studies or action research projects for experienced teachers enrolled in graduate courses. Through their own investigations, they will have more control of their learning goals and benefit from the support system of their college professors to guide their research process.

Some literature calls for additional funding for professional learning (Kent, 2004; Cohen & Ball, 2001); yet, this study's findings imply that teachers value meaningful professional learning that addresses their defined learning needs. Literature that explores professional learning in high performing schools underscores how these educational communities utilize collaboration and professional learning communities. In particular, Shannon and Bylsma (2004) outline nine characteristics of high performing schools, which include mentoring, peer support, action research activities, lesson study, walk through, professional learning communities, and program specific professional learning

opportunities. The findings from this present study supported some, but not all, of these characteristics in that the participants described learning how to teach through individual research, collaboration with others, and in a few cases professional learning communities. The participants spoke favorably about professional learning opportunities in which they were able to develop their learning goals and contribute to the context of the engagement process. Alternatively, teachers were more critical of formal professional learning opportunities that directly relate to teaching mathematics. Among the nine characteristics offered by Shannon and Bylsma (2004), the participants in this study did not specifically mention action research opportunities, walk-throughs, lesson study initiatives, or formal mentoring programs. However, the participants did mention informal peer observations and seeking out knowledgeable peers with which to collaborate or to seek advice. These activities were typically not planned by authoritative figures; rather, the opportunities were created by the teachers themselves. These refute the findings of Many and King (2008) who suggest that successful schools maintain their high performing status through the implementation of top-down models of professional learning communities. The present study found that the professional learning communities formed by the teachers themselves produced more positive learning experiences than those in which collaborative teams were assigned by authority figures for the purpose of subject area teams or common planning groups. Additionally, participants discussed other types of professional learning that was not mentioned in the literature, including taking online and graduate level classes, “floating” into other teachers’ classrooms, and attending state and national conferences.

In terms of funding, the teachers criticized wasteful spending on one-size-fits-all initiatives pertaining to technology, motivational speakers, and, as Ed asserted in his

interview, “self-promoting” strategies that did not take root within their schools. Curriculum reforms have made many of the teachers feel uncomfortable. However, they have not felt supported, and actually felt the district did not know how to help them, even though they were required to go to these sessions. They were instructed on how to teach tasks, but they were not given the big picture of the curriculum.

Professional developers seeking to help teachers grow should consider developing workshops which foster specific, relevant skills that clearly relate to teaching and learning mathematics. In particular, when the participants in this study wanted to learn about technology, they desired time to work with the technology, ask questions with a peer, and receive additional support from instructors when they needed advanced help. Not only that, some participants desired training that was not offered (technology), were required to go to trainings that were irrelevant (Maple, iRespond, interdisciplinary), or desired to go to sessions that felt like a waste of time (curriculum reform trainings).

Additionally, curriculum reformers need to keep in mind that teachers like Betty need additional support within the school. Although they are committed to spending their own time planning for the following year, they merely need to see the “big picture” in order to feel more comfortable with the curriculum so that they can plan. The participants in this study claimed that the mandated professional learning sessions simply did not meet their needs.

The thoughts, experiences, and words of wisdom from these participants echo in my mind. They remind me of a time when I was an undergraduate mathematics education student at the University of Georgia. I was conversing with a friend who was already a practicing teacher, who pointed out, “You just wait. The perspective is a whole lot different

from the other side of that desk." Truly, the transition from being a student learning about teaching mathematics to a teacher learning how to teach mathematics was a difficult evolution riddled with several moments of growing pains. Each of the teachers in the study agreed that teachers *should* want to learn, and those who are not motivated to pursue professional learning should be mandated to participate. The findings of this study support the notion that teachers believe that a positive attitude toward learning is an important pillar of an educator's professionalism. However, their definitions of professional learning are all quite different. Left to their own devices, how would these teachers learn to teach mathematics? Would they even choose to learn?

Pragmatically, they all noted that there were going to be teachers who should also be mandated to participate in professional learning sessions. Why do teachers believe they are capable of developing their own professional goals, yet their peers cannot? Truly, if a colleague does not chose to participate in professional learning, those offering the professional learning should ask teachers why they do not want to attend instead of merely mandating them to go. This study suggests that teachers consider several characteristics about professional learning, and assess the opportunity based on both content and the professional learning structures that are provided. The findings from this study underscore the fact that teachers vary in learning needs, educational backgrounds, personal priorities, and educational philosophies.

Job Satisfaction and Professional Learning

Exploring the participants' morale and intentions to continue teaching was eye-opening. At the beginning of the study, I considered choosing teachers for this study who maintained different philosophies of teaching mathematics; however, I neglected to take into

account whether they actually enjoyed teaching. The participants' morale in this study demonstrates the reality of a wavering educational transient rate. I believe that the morale of the teachers in the study was low due to environmental factors out of the participants' control: curriculum reform, collaborative teams, administrative support, and lack of supportive materials for teaching and for their students. The participants in this study indicated that they wanted to leave their school for several reasons. Those who stay may be unhappy in their profession, and teachers with high morale may choose to leave altogether for personal reasons. To what extent does the transient rate of the teaching faculty impact development of professional learning opportunities? Perhaps a simple inquiry of needs and barriers can support teachers, and help those with low morale to have a more positive outlook towards teaching.

The implications of low morale on the professional learning process is that professional developers must be cognizant that their participants are learners with different support systems, different motivations for teaching, and different learning needs. Although professional developers and facilitators may not have the authority to directly affect the stress factors within each educational context, these contexts do directly influence the professional learning process. Teachers' educational contexts, personal investment in their career, and learning goals all influence how they are invested in the professional learning process. Would a teacher who planned to retire the following year truly be as interested in learning a new curriculum if they knew they were not going to be around to teach it?

Considering the job satisfaction and long-term career goals of teachers is a critical, but often a forgotten detail unconsidered by professional developers. Truly, how would the foresight of knowing teachers' commitment to teaching influence the decisions of those who

have the power to provide professional support? Would struggling teachers be specifically targeted or disregarded? Would mandated meetings only be required for non-retiring teachers? Within contexts of curriculum reform, it seems more difficult to motivate teachers to learn something new when teachers have decided that they do not even want to teach.

During moments when teachers needed help but did not receive support from authority figures, teachers created learning structures by seeking out related resources or trusted teachers. Within small groups, teachers were empowered to plan, problem solve, create knowledge, and discuss subject-specific topics that are often left out of graduate classes or mandated professional learning sessions. Although most of the participants from Site 1 had substantially smaller logit measurements (implying they supported more teacher-centered practices), it should be noted that these teachers did not teach Advanced Placement or gifted courses. Additionally, these participants expressed that their curriculum was in a constant state of flux due to curriculum reforms. However, most of the participants from Site 2 who maintained higher logit measurements (indicating they had more student-centered practices and beliefs) taught AP and honors-level courses for several consecutive years. That being said, Ed, as the department chair had some authority (along with the school's administrator) in determining his schedule and the schedules and teaching teams of every member of his department. Both Ed and Ellen most likely maintained some seniority and respect because of their teaching experience and areas of expertise. Although they both explored a wider variety of methods for their own professional learning, to some extent, both Ed and Ellen were comfortable in their own methods for learning. Additionally, Laura explained that because she had been teaching the same AP and honors-level classes for the past five years, her primary learning goal was to polish up what and how she was teaching.

Why is the teachers' content matter relevant to the professional learning? Teachers at Site 1 primarily taught 9th and 10th grade non-honors mathematics courses, and their logit scores implied that they held more teacher-centered perspectives about teaching and learning mathematics compared to the Site 2 teachers. This variable, the content and duration of what teachers were teaching, could also influence their perspectives of teaching and learning mathematics. For example, Betty indicated that she had to "recreate the wheel" (Interview) every year for the past five years. Betty valued planning and structure, and so she indicated that she spent a great deal of time, sometimes 14 hours a day (Follow-Up Meeting) planning the curriculum she was teaching. In contrast, Laura had taught the same honors level course for several years in a row. She expressed that her goal was to "fine-tune" (Interview) her instructional practices. Whereas Betty was focused on content and structure, Laura broadened her scope to improvement because she was confident in her content knowledge.

As school districts and state governments scramble to provide opportunities to support educators as they transition from old to new curricula, those who develop professional learning opportunities would likely find it productive to allow teachers some autonomy with respect to developing their own goals, mapping out their curriculum, and working with other teachers from similar contexts and backgrounds to plan the course. The findings of the present study suggest that teachers who have been teaching a course for fewer than five years are more concerned about learning what they are teaching instead of how they should be teaching it. Additionally, teachers who had been teaching the same courses for a long period of time were more willing to explore related topics pertaining to other content areas or technology. Therefore, school systems and professional developers should consider the learner needs pertaining to teachers, what they teach, and how long they

have been teaching their newest course, as these elements may be related to the learners' preferences for professional learning structures, collaborative groups with whom they work, and methods for connecting and assessing their knowledge with respect to their students.

Concluding Remarks

Despite the numerous studies on teachers' professional learning, a paucity of research addressing teachers' perspectives of teaching and learning exists. The purpose of this study was to explore the mathematics teachers' perspectives of professional learning and to contribute to the present body of knowledge that explores the relationships between teachers' beliefs, professional learning, content knowledge, and pedagogical practices. Zeichner (2010) asserted that contemporary efforts to bridge gaps between school-based teacher education and larger educational communities, including their schools and local universities, involve an important paradigm shift from which "academic knowledge is seen as *the* authoritative source of knowledge about teaching" to one which "different aspects of expertise that exist in schools and communities are brought into teacher education and coexist on a more equal plane with academic knowledge" (p. 95). It is my hope that through the seven presented Professional Learning Profiles, teachers, educational leaders, mathematics educators, and researchers may identify with or identify others who share the participants' stories of learning, teaching, and mathematics. The participants shared stories to illustrate how teachers learn through various stages of their career, from the new teacher who floats into classrooms and gathers advice on classroom management, to more seasoned teachers who taught for over 30 years and want to focus their professional learning experiences on making mathematical connections inside and outside of the classroom. The Professional Learning Profiles detail the participants' goals and professional learning

preferences as well as reveal some of their perspectives of teaching and learning mathematics. Their stories reveal that they learning through the pattern of a Professional Learning Sequence, and the themes of Establishing Relevance, Contexts, Resources, and Time for professional learning were all discussed. Therefore, through the teachers' voices, stories, reflections, and interviews, the various perspectives of the seven teachers in this study revealed that how, when, why, and what teachers learn are as unique as the learners themselves.

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APPENDICES

Appendix A: The Survey Instrument

First and Last Name: _____ School: _____

Section I – Demographical Information

1. What is your gender (please circle one)? Male Female

2. What is your race (please circle one)?

African-American Asian-Pacific Islander Hispanic White

3. What is your age?

20-29 30-39 40-49 50-59 60+

4. Which grade level(s) do you teach (circle all that apply)? 9th 10th 11th 12th

5. Please circle your highest degree earned and any additional endorsements you have earned.

Bachelors Masters Specialist Doctorate

ELL Endorsement TSS Endorsement Gifted Endorsement Other: _____

6. What type of degree have you earned (either as an undergraduate or within graduate studies)?

Mathematics Math Education Both Neither

7. Including this year, how many total years of teaching experience do you have?

0-3 4-9 10-15 16-20 21-25 25+

8. After this year, how many years do you plan to teach?

0-5 6-10 11-15 16-20 21-25 25+

Section II – Follow-Up Interest

9. Please sign below if you are willing to participate in the second phase of this study as outlined by the consent form.

_____

Section III – Multiple Choice

For each question, choose the one choice that most often describes your beliefs.

10. I believe when introducing a new concept it is most important to teach mathematics lessons that:
    a. Focus on one idea at a time, emphasizing both reasoning and computational accuracy together.
    b. Combine a variety of ideas and their connections using a problem solving approach.
    c. Combine at least two ideas and the connections between them.
    d. Focus on one idea at a time, emphasizing computational accuracy before reasoning.

11. I believe the most important role of the mathematics teacher is to:
    a. Convey information to students and evaluate student performance.
    b. Explain reasoning for mathematical processes to students, assist students in clarifying their mathematical understanding and assess their mathematical knowledge.
    c. Provide information to students, question them about their knowledge, and seek to understand their thinking.
    d. Pose problems that engage students in exploring mathematical ideas and assess their mathematical understanding.

12. I believe that students learn mathematics best by:
    a. Paying attention to the teacher and practicing problems.
    b. Exploring student-generated mathematical problems found in their environment.
    c. Taking notes during lessons and asking questions when they don't understand.
    d. Participating in mathematical investigations in which the teacher designs the questions.

13. I believe that it is important for mathematical conversations to most often be in the form of:
    a. Teacher and student discussion driven by student inquiry.
    b. Teacher and student discussion with the teacher initiating questions.
    c. The teacher initiating questions to determine whether or not students have correct answers.
    d. Students talking with other students while the teacher facilitates questioning.

14. I believe it is important to learn math because it:
    a. Provides structure.
    b. Promotes logical reasoning.
    c. Is beautiful and creative.
    d. Is useful.

15. I believe that mathematics:
    a. Is invented.
    b. Is already all known.
    c. Exists independent of human thought and is discovered.
    d. Is constructed as a product of social interaction.

16. When I prepare lessons I believe it is most important to consider the following:
    a. Activities or investigations that will assist my students in developing their own understanding about the key mathematical ideas.
    b. Opportunities for group activity to be used after I convey key information.
    c. Explanations I want to give in a class discussion along with questions I want to ask students during the lesson.
    d. Key information I want to convey in a lesson along with student practice problems.

17. In order to teach students how to factor quadratic polynomials, I believe it is most important to:
    a. Present students with the procedure for factoring and then have them practice individually factoring polynomials.
    b. Use manipulatives to demonstrate using an area model for factoring polynomials with the whole class and then have students work in groups to practice factoring polynomials.
    c. Provide student groups with manipulatives and facilitate groups in creating a model for factoring.
    d. Present students with the procedure for factoring and then have them work in groups to practice factoring polynomials.

18. I believe mathematics is mostly:
    a. Problem solving.
    b. Proving existing ideas.
    c. Computation and manipulation.
    d. Creating new ideas.

19. I believe mathematics is most like:
    a. A lawyer's courtroom argument.
    b. A painting.
    c. Cooking.
    d. A 1000-piece jigsaw puzzle.

20. I believe that the most important source of mathematical ideas in the classroom is:
    a. The teacher and the students.
    b. The curriculum.
    c. The teacher.
    d. The students.

21. I believe:
    a. Learning is a mostly individual process that is aided by discussion with the teacher.
    b. Learning is an individual process accomplished by the learner alone.
    c. Learning is a process of social construction that takes place through discourse with a variety of others.
    d. Learning is a process that is accomplished through discussion with other learners and a teacher.

22. I believe that the body of mathematical knowledge is:
    a. Fixed with interconnecting structures.
    b. Fixed and predictable.
    c. Surprising, expanding and driven by new problems.
    d. Surprising and investigated through solving of existing problems.

23. I believe that:
    a. There are multiple ways to learn a mathematical topic.
    b. There is a best way to learn a mathematical topic but it may be represented in more than one way.
    c. Mathematics is learned through problem-solving in which multiple pathways to solutions are possible.
    d. There is a best way to learn a mathematical topic.

24. I believe that students learn the process of completing the square best by:
    a. Working in groups to complete several completing the square problems and discussing the solutions with the group.
    b. Repeating the steps of completing the square and explaining them to a classmate.
    c. Memorizing the steps of completing the square and practicing them.
    d. Working with a group using manipulatives to derive the process and then generalize it.

25. I believe that eliciting students' mathematical thinking in classrooms should be accomplished by:
    a. The teacher asking students to explain why their answer is valid.
    b. The teacher asking questions of students to check to see if students have the correct answers.
    c. Students questioning each other about their reasoning with teacher facilitation.
    d. The teacher asking students to explain how they solved a problem.

26. I believe it is most important to ask questions during classes:
    a. To assess whether or not students are paying attention.
    b. To encourage further student exploration and, if necessary, change direction of a lesson.
    c. To evaluate student knowledge.
    d. To better understand my students' thinking.

27. I believe it is most important for students to learn to:
    a. Generate and explore their own mathematical questions.
    b. Explain reasoning for processes and explore connections between problems.
    c. Solve problems and explain reasoning for processes.
    d. Solve specific problems accurately.

28. I believe it is most important during lessons to:
    a. Allow students to present solutions only after I have checked them for correctness.
    b. Allow students to present different methods of a solution than I have presented.
    c. Allow students to present solutions and use any misconceptions that surface to propel instruction.

d. Have the teacher present all solutions so that students are not confused by multiple or incorrect solutions.

29. In order to teach solving linear equations, I believe it is most important to:
    a. Show several examples of solving linear equations with questions asked to check for student understanding incorporated into the demonstration.
    b. Show several examples of solving linear equations and then have students practice solving individually.
    c. Explain the reasoning that creates the rules for solving equations while demonstrating solutions of linear equations.
    d. Engage students in conversation that leads to the development of multiple ways to solve linear equations.

Section IV - Free Response Questions

30. What are the first three words that come to your mind when describing your **school**?
    _____.

31. What are the first three words that come to your mind when you think of **professional development**?
    _____.

32. Complete this sentence: The **ideal mathematics teacher** must:
    _____.

33. Money no object, you would design your next professional learning experience to focus on:
    _____
    _____

34. Leave any additional comments below.

Appendix B: Professional Learning Journal Articles

DuFour, R. (2011). Work together: But only if you want to. *Phi Delta Kappan, 95*(5), 57–61.

Easton, L. B. (2008). From professional development to professional learning. *Phi Delta Kappan, 89*(10), 755.

Gabriel, R., Pereira, J. D., & Allington, R. (2011). Exemplary teacher voices on their own development. *Phi Delta Kappan, 92*(8), 37–41.

Richardson, V. (2003). The dilemmas of professional development. *Phi Delta Kappan, 84*(5), 401–406.

Roney, K., Brown, K. M., & Anfara, V. A. (2004). Middle-level reform in high performing middle schools: A question of implementation? *The Clearing House, 77*(4), 153–159.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4–14.

Schmoker, M. (2009). What money can't buy: Powerful, overlooked opportunities for learning. *Phi Delta Kappan, 90*(7), 524–527.

Wiggins, G., & McTighe, J. (2006). Examining the teaching life. *Educational Leadership, 63(6*), 26–29.

Appendix C: Professional Learning Journal Reflective Note Sheet

Reflective Notes Sheet

1. Highlight a quote or quotes that resonate with you from this article(s).

2. Why is this significant to you?

3. Identify a professional experience, if one exists, that serves as an example or counterexample to this quote. Summarize the experience and explain how this experience is related to your highlighted quote.

4. On a scale from 1 to 5, (with 1 being the worst score and 5 being the best), how would you rate this article? Why?

Appendix D: Examples of Semi-Structured Interview Questions

The following are sample questions for the semi-structured interview conducted during this study.

Teaching Mathematics

1. *What do you think is the most difficult part of teaching mathematics?*
2. *If you had to quit being a math teacher tomorrow and pick to either teach or go into a purely math related field, which would you choose and why?*
3. *If you were assigned to teach a new mathematical subject, how would you go about preparing for to teach the course?*
4. If you knew you were going to teach the course for at least 5 years, how would you prioritize your learning goals in preparing to teach the course?
5. *Describe your image of an expert or quintessential math teacher.*
6. *What should he or she know and do?*
7. *Does she possess a particular type of educational background?*
8. *What types of behaviors does she have in class?*
9. *How does she interact with her students?*
10. *How does she interact with her peers?*
11. *Are you an expert math teacher?*
12. To what degree to you feel *you* need support in learning about:
    Teaching mathematics
    Mathematical content
    Promoting mathematical learning

Conceptions of Professional Development

1. Do you consider professional learning to be embedded within or separate from your profession? In what ways?
2. In what school structures do math teachers perform most effectively? Explain your response
    - Professional learning communities (within school)
    - Collaborative teams (within the math department)
    - Working individually
3. Is professional learning the same as or different from professional development? In what ways?

Goal Setting

1. Do you have any short-term or long-term professional goals? If so:
2. What are they and who defined them?
3. In what ways are you (if at all) are you planning on progressing toward those goals?
4. If any, describe obstacles that interfere with you obtaining these goals.

Professional Learning Experiences

1. What type of professional learning are you least likely to use in your practice? Why?
    Learning theories "How to teach" strategies Content
    Technology/Manipulatives

2. Describe an instance where you tried out something you learned from a professional learning experience in your classroom.
3. How did you determine whether this new knowledge improved (or did not improve) your practice? What is an indication that the idea did or did not work…?
4. Have you used this practice or idea again? Why or why not?
5. What types of professional learning do you find most meaningful?
6. What types of professional learning do you find least meaningful?
7. Tell me about a positive professional learning experience, if you have had one.
8. Tell me about a negative professional learning experience, if you have had one.
9. Do you enjoy teaching at your school? What are the pros and cons of teaching in your school with respect to how these factors influence your professional growth?
10. What are the first three words that come to mind when you think of your school? Please elaborate on your response.

Appendix E: Study Timeline

February 2012
- Develop materials and blog for study
- Submit proposals to IRB

March 2012
- Submit proposal to the school district
- Distribute surveys to selected sites

April 2012–May 2012
- Select participants
- Conduct interviews
- Monitor blog

June 2012
- Gather materials from participants
- Digitally organize data for analysis

July 2012–March 2013
- Analyze data
- Memo and reflect on process and emerging findings
- Refer to literature throughout the process
- Follow-up interviews
- Member checking data

February 2013–May 2013
- Write up findings and discussions

May 2013
- Defend dissertation

June 2013
- Complete edits and revisions

July 2013
- Submit final copy of dissertation to the university