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Rural Elementary Teachers And The Impact Of Professional Development On Mathematics Instruction

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RURAL ELEMENTARY TEACHERS AND THE IMPACT OF PROFESSIONAL DEVELOPMENT ON MATHEMATICS INSTRUCTION

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ABSTRACT

Rural elementary math teachers often lack a background in mathematics and even those with a strong mathematics background can sometimes struggle to model elementary math concepts (Holm & Kajander, 2019). Professional development (PD) provides teachers with an opportunity to increase their knowledge and skills while in the field. Although there are clear guidelines of what constitutes high-quality PD, not all PD achieves the same outcomes for teachers and students. The purpose of this qualitative descriptive case study was to understand PD experiences from the viewpoint of the rural elementary teachers, specifically the ways the PD experiences impact teacher efficacy and beliefs around mathematics instruction and learning. Eight elementary teachers from a rural district participated in the study. Three research questions guided the descriptive case study: (1) How do PD experiences impact rural elementary teachers' beliefs about their abilities to teach mathematics? (2) How do PD experiences impact rural elementary teachers' efficacy in regards to mathematics instruction? and (3) How do rural elementary teachers describe how PD impacts their perception of mathematics instruction? To answer these questions, data were collected with two rounds of semi-structured interviews, a classroom observation of each participant, and shared artifacts such as notes or classroom products.

Themes that emerged from the data, leading to recommendations. Teachers revealed that collegial interactions in the form of observations and conversations helped them gain confidence in their abilities to teach math. They noted that PD experiences could have a positive or negative impact on their beliefs in their abilities to teach math. Participants disclosed that, when tools and strategies were easily implemented, they gained confidence and enthusiasm about their abilities to impact student achievement. PD sessions were most effective when facilitated by someone who took time to build trust and rapport with teachers. This study found that PD does impact rural teachers' beliefs and teacher efficacy, teachers want to share their experiences, and a culture of trust is essential for continuous improvement. It is recommended for those who are responsible for providing PD to listen to the needs of their teachers when designing it and incorporate all key components of effective PD experiences.

Keywords: Professional Development, Elementary, Rural, Teacher Efficacy, Mathematics, Mindset

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CHAPTER ONE

INTRODUCTION

The classroom teacher is the key component of a high-quality educational experience (Hattie, 2012; Opper, 2019). Teachers can spark interest in topics, engage students in deep, meaningful discussions, and support mastery understanding of content and skills. The ability of a teacher to change a child's trajectory in life cannot be understated. According to Whitaker and Steele (2019), "students are not motivated by lessons; they are motivated by teachers" (p. 8). Some teachers can motivate and engage students to learn even the most difficult concepts. This ability is one that differentiates the average classroom teacher with a highly effective teacher (Marzano, 2017). Educators can become more effective teachers by participating in professional development (PD) experiences to enrich their understanding of concepts (Barrett et al., 2015; Smith et al., 2013). PD experiences should include facilitating professional learning that creates an in-depth conceptual knowledge and understanding that allows teachers to transfer their knowledge in a meaningful way to students (Le Fevre et al., 2020; National Research Council, 2012).

When providing instruction, teachers must "understand ideas and see them from the perspective of others who are first encountering them" (Ball & Forzani, 2010, para. 11). Further, teachers must have a deep understanding of the content, recognize common misconceptions, and be able to adjust instruction to meet the needs of their students. This is especially true for mathematics instruction when teachers must be aware of their grade-level content and the progression of the content from previous grades to future grades (Smith et al., 2013). For elementary teachers who are often responsible for teaching all content areas to a specific group

of children, this can be a difficult task without the support of quality PD. Some school districts may embed PD experiences within a school year to provide targeted support for staff. There are even federal funds available from the US Department of Education, such as Title IIA – Teacher and Principal Training and Recruiting Fund dedicated to "improving teacher and principal quality" (2016, para. 1). The US Department of Education (2016) provides guidance for what constitutes quality PD, yet not all experiences are created equal. District and building leaders plan with teachers on their individual and collective needs to develop the most appropriate PD experiences. District and building leaders must prioritize needs when choosing PD, as the money allocated for these experiences can be limited (Lowe, 2018; Smith et al., 2013).

This study sought to examine the experiences of a group of rural elementary teachers after they participated in a PD experience focused on mathematics instruction. Specifically, the study explored the elementary teachers' belief systems about mathematics, including their own mathematics teaching efficacy and beliefs about what constitutes quality math instruction in the elementary classroom. These teachers are from a district with consistently low math achievement scores on the mandated state test. The mandated state test is used to determine the effectiveness of the mathematics program and scores are shared publicly. The information learned provided key insights into how rural elementary teachers experienced a targeted mathematics PD experience, as well as other past PD experiences, and can inform future PD experiences.

Statement of the Problem

According to the National Council of Teachers of Mathematics (2014), mathematics instruction is based on learning projections that require teachers have an understanding of their grade-level content, as well as the material taught in previous and subsequent years. Yet,

according to the Association of Mathematics Teacher Educators (2013), elementary teachers often lack a significant mathematics background. According to a survey conducted by Horizon Research (2019) only 3% of elementary math teachers had a degree in mathematics according to a survey done in 2018. Even those with a strong mathematics background can sometimes struggle to model elementary math concepts (Holm & Kajander, 2019). In the most crucial, foundational years of education, when students are building the essential knowledge and skills to understand higher-level mathematics thinking, they are often taught by teachers lacking the understanding and skills to teach those concepts. According to the National Assessment of Educational Progress (NAEP) mathematics report card (n.d.), the average fourth-grade student is below proficient in mathematics, creating a heightened level of concern for the quality of mathematics instruction. The problem of finding qualified teachers is amplified by teacher shortages in mathematics (United States Department of Education, 2019). Rural districts can experience a greater need, as they work to recruit teachers to teach in more remote areas (Lowe, 2018).

One way to change this narrative is to provide quality PD experiences in mathematics concepts and skills to elementary teachers. Districts must support and retain their current teachers by providing them with the skills and knowledge to teach mathematics in an effective manner starting with the youngest students (Barrett et al., 2015; Carney et al., 2016). Kyoung-oh et al. (2018) found that high-quality PD was associated with greater job satisfaction, higher expectations for students, and more positive attitudes among teachers around implementing the curriculum. They also found that although there were positives from PD, data from teachers around the world show that only half of the mathematics teachers had actually participated in PD focused on mathematics. If districts can embed PD experiences within their school that impact

teachers' instructional practices and beliefs about mathematics, they may positively impact student achievement.

Purpose of the Study

The purpose of this study was to examine the experiences of eight rural elementary teachers after they participated in a mathematics PD. The participants ranged in their teaching experience and the grade levels they taught from kindergarten to fifth grade. The study was a qualitative, descriptive case study to gain an in-depth understanding of rural teachers' perspectives of a PD experience in terms of personal learning and their classroom instruction. There is a gap in the literature where the voice of the educator is lost behind student achievement numbers, goals of the PD, or other quantitative data collected. This study sought to highlight the educators' voices and beliefs about mathematics education as a driving factor in determining the impact of the PD experience.

Participants of the study were asked to describe how the PD impacted their beliefs around mathematics instruction, their own perceived abilities in mathematics, and ideas and thoughts specific to the PD experience through semi-structured interviews. The researcher collected data through classroom observations of participating teachers and other evidence such as notes from PD sessions, exit slips, and classroom artifacts that provided information on how the PD influenced classroom instruction. The data gathered offered a comprehensive understanding of how PD impacted each teacher individually, as well as contributing key insights on the impact collectively in classrooms. The data may inform future PD efforts in other rural elementary schools, as well as supporting mathematics PD in the future.

Research Questions

The goal of this descriptive case study was to explore the mathematics PD experience from the perspective of the rural elementary teachers involved. It was guided by the research questions below.

RQ_1: How do PD experiences impact rural elementary teachers' beliefs about their abilities to teach mathematics?

RQ_2: How do PD experiences impact rural elementary teachers' efficacy in regards to mathematics instruction?

RQ_3: How do rural elementary teachers describe how PD impacts their perception of mathematics instruction?

These questions arose from the literature review as well as the theoretical framework as described in Chapter Two. The questions provided the lens for the questions asked in the semi-structured interviews and for analyzing classroom observations and artifacts.

Conceptual Framework

In qualitative research, a conceptual framework "organizes and focuses the study" (Bloomberg & Volpe, 2019, p. 167). The conceptual framework guiding this research is focused on the intersection between a quality PD experience, the emotional component of teaching, and teacher efficacy. Self-efficacy was first introduced by Bandura (1986) as a social-cognitive theory to explain how some individuals have a belief in their ability to accomplish something. People who have a high self-efficacy tend to take more risks and challenge themselves more to persevere through failures (Bandura, 1997). The theory of efficacy has been transferred into education and termed teacher efficacy. Teacher efficacy is the belief of a teacher that how they teach in the classroom will positively impact the students they teach (Katz & Stupel, 2016).

Teachers with a higher teacher efficacy will take instructional risks in the classroom, push their students to achieve more, and emphasize problem-solving (Bray-Clay & Bates, 2003). Nurlu (2015) found that teachers with a higher teaching efficacy were open to new ideas, emphasized student relationships, and took more responsibility for student success. Carney et al. (2016) found a PD experience could have a positive impact on teacher efficacy, specifically in the content area of mathematics.

The study was conducted in a rural location as there is a gap in the literature focused on mathematics PD for elementary teachers in rural locations. Rural educators often have less access to face-to-face quality PD experiences due to their location (Barrett et al., 2015). They also often have to carry multiple roles within a school setting to support students and other staff members (Glover et al., 2016). There are fewer people to accomplish the work required by various components of the educational system. Educators can also feel isolated as they navigate their classroom and role without access to instructional coaches or other supports that larger, more urban districts can support (Glover et al., 2016). PD provides higher job satisfaction and promotes retention of educators in school districts (Kyoung-oh et al., 2018). Job-embedded PD experiences allow teachers to strive for continuous improvement while not adding another thing to their already full-plates. This study focused on understanding the PD experience from the rural teachers' perspective.

Topical Research

The United States Department of Education non-regulatory guidance for Title II Part A (2016) provides a framework of the characteristics of high-quality PD experiences stating that it should be job-embedded, sustained, intensive, collaborative, and classroom-focused. The literature around elementary mathematics PD demonstrated an emergence of the concept of

teacher efficacy and teachers' general beliefs about mathematics instruction as specific areas to examine when reviewing PD experiences (Carney et al, 2016; Porter, 2019).

Assumptions, Limitations, and Scope

This study had an inherent assumption, as with any research that relies on respondents' answers in an interview or discussion. The findings of the research were dependent on the participants providing forthright and honest responses. The researcher strived to build trust with those who are participating, so their responses were assumed to be sincere and provided key insights, but they were limited by their own experiences in education and worldview. The educators responded frankly and honestly, not in a manner in which they believed the researcher was expecting them to answer; the professional relationship is not perceived as a limitation of the study. There were some responses that are similar due to teachers who have worked together for an extended length of time have developed a similar philosophy of mathematics education. By including teachers with varying years of teaching experience as participants in the study, the commonality of experiences was somewhat mitigated. As a descriptive case study, the study was limited due to the sample population as well as the methodology.

The scope of the study was centered around one school district in a rural community in the northeastern United States. The goal of the study was to gain a deeper understanding of the participants' individual and collective experiences after having participated in a math PD. A descriptive case study with eight elementary teachers who teach math, as well as other content areas, to grades from kindergarten through grade five provided a view from multiple perspectives versus a single-grade level. The experiences of these rural educators may not be similar to other educators in a different setting and should not be generalized to all settings (Merriam & Tisdell, 2016). There were characteristics or themes that emerged that will inform future PD in

elementary mathematics given a similar setting or staff with similar characteristics. The information gained expanded the work concerning teacher efficacy in rural education settings.

Rationale and Significance

Mathematics achievement scores in Maine have had roughly 70% of students in grades 3-8 not meeting the state benchmark for the last three years (Maine Department of Education, 2020). These data indicate that mathematics instruction in this predominantly rural state is not meeting the needs of the students to the level of understanding necessary to show evidence of meeting the standards. One key influence on student achievement is the effectiveness of instruction within the classroom (Marzano, 2017; Stronge, 2018). Due to teacher shortages and the lack of teacher candidates, the most effective way to improve instruction within the classroom is to provide high-quality PD for teachers who are currently delivering instruction (Barrett et al., 2015).

Although there are benchmarks of what constitutes a high-quality PD experience, not all PD experiences are created equal (Glover et al., 2016). It is vital to have the voices of the educators who are participants in the PD sharing their thoughts, concerns, and ideas about how the PD is impacting their beliefs, assumptions, and practices within the classroom. Educators need to provide insights on how to improve the PD experience to capitalize on every dollar spent on PD. This descriptive case study examined these key components to provide a comprehensive understanding of one rural school district's attempt to change mathematics instruction moving forward.

Definition of Terms

Elementary Teachers are educators who instruct or deliver instruction to students in grades K-8, usually designated for teachers instructing students in grades K-5 (Maine Department of Education, 2020).

Fixed Mindset is the belief that intelligence is static and innately determined by genetics and environmental factors (Dweck, 2007).

Growth Mindset is the belief that intelligence can be developed with the appropriate instruction, feedback, and support (Dweck, 2007).

Professional Development is defined as diverse learning opportunities that allow an individual to receive more knowledge and skills that will enable them to become more effective in their job (United States Department of Education, 2016).

Rural is defined by National Center for Education Statistics (NCES) as being "those areas that do not lie inside an urbanized area or urban cluster" (2006, para 3).

Self-efficacy is the belief of an individual that what they do matters in determining the outcome of a situation (Bandura, 1986).

Teacher Efficacy is defined as a teacher's belief in what they do in the classroom can have a positive impact on the students they are teaching (Bray-Clay & Bates, 2003).

Conclusion

The goal of this case study was to examine mathematics PD experiences from the perspective of rural elementary teachers in a specific school district. Elementary teachers may have a general elementary certificate with the minimal math courses required for certification, yet are required to spend a portion of each of their day teaching the subject to students in their classrooms. By using the teacher efficacy theoretical framework, this study examined if a PD

opportunity had any impact on teachers' belief systems about mathematics for themselves or their students. In the upcoming chapters, there will be a detailed literature review, a more significant examination of the conceptual framework, and a full description of the methodology used within the study. This chapter provided some key highlights to ideas that will be explored more rigorously in the upcoming chapters.

CHAPTER TWO

LITERATURE REVIEW

This literature review is a thematic review of the concepts that emerged when examining elementary mathematics professional development (PD). It will explain the impact of PD on elementary mathematics education in rural settings. The review will encompass an analysis of the effective components of PD models, the emotional component of learning mathematics including mathematical mindsets, and the impact of mathematics teacher efficacy. The embedded conceptual framework is built around the intersection between a quality PD experience, the emotional component of instruction, and teacher efficacy. The literature review concludes with a look at the need to match the goals of PD with changes in instructional practice.

The Study Topic

The literature review began with key word searches of professional development, elementary mathematics, and student achievement. High-quality PD was defined as being "sustained…, intensive, collaborative, job-embedded, data-driven, and classroom-focused" (United States Department of Education, 2016, p. 11). PD is how schools and districts continue to improve the quality of teachers in their classrooms (Lowe, 2018). Effective teachers have a positive, lasting impact on students (Stronge, 2018). It has been shown a teacher's instructional practices can impact student's motivational framework in the early elementary grades (Park et al., 2016). A motivational framework is what activates students to want to learn. Teachers need to be adequately equipped with knowledge of the content and evidence-based instructional practices to have a positive impact on student achievement (Clarke et al., 2014; Selling et al., 2016).

The Context

As studies were reviewed, the concept of teacher efficacy emerged as a contributing factor to student achievement in elementary mathematics classrooms (Bray-Clay & Bates, 2003; Green & Kent, 2016; Harbin & Newton, 2013; Yoo, 2016). Teacher efficacy is the belief in one's ability to effectively teach students and positively impact achievement (Giles et al., 2016). Nurlu (2016) found teachers with a higher efficacy have characteristics that were different from those with a lower efficacy. For example, those with lower efficacy were more apt to blame other factors such as home environment and previous learning experiences when students were not successful, while those with higher efficacy directly related student achievement to their ability to teach the concept in a manner that students could understand it (Nurlu, 2016). When teachers have a higher self-efficacy, they are more willing to take risks, push students to go deeper in their understanding, and will problem solve with others to persist through challenges (Bray-Clay & Bates, 2003; DiPaola & Hoy, 2015). Those with higher efficacy are also more willing to engage in professional learning and work to build student relationships (Nurlu, 2016).

The broadened search surfaced another concept around the emotional component of learning mathematics, both from the teacher and student perspective. A study by Beilock et al. (2010), found when female elementary math teachers were anxious about math there was a negative relationship on the female student achievement data in the classroom. Elementary teachers with anxiety around teaching math have been shown to negatively impact the achievement of their students (Hadley & Doward, 2011). As it was apparent a teacher's own beliefs around mathematics could impact student learning, the inquiry expanded to focus on the intersection between PD, the emotional factors in a mathematics classroom, and teacher efficacy.

The Significance

Rural districts face challenges due to limited access to resources, as well as a smaller pool of teacher candidates (Barrett et al., 2015). Teacher shortage areas in content areas such as mathematics can increase the problem (United States Department of Education, 2019). PD can be a costly endeavor to rural districts yet is the primary way of improving instructional practices of staff. If districts want to raise the math achievement of their elementary students, the PD provided must be focused on all three components of content, self-efficacy, and mathematical mindsets of teachers and students.

Elementary teachers do not always have a strong mathematics background (Association of Mathematics Teacher Educators, 2013). They can have a low self-efficacy related to math, as well as having math anxiety around teaching concepts to elementary students (Beilock et al., 2010; Hadley & Doward, 2011). PD programs need to provide elementary math teachers with opportunities to learn the content, implement sound instructional practices, and collaborate with other teachers to determine the positive impact on student achievement (Barrett et al., 2015).

Conceptual Framework

According to Roberts and Hyatt (2019), the conceptual framework allows the researcher to view their study with a more focused field of vision. This conceptual framework is composed of three major components: personal interest, topical research, and the theoretical framework. The personal interest provides the viewpoint of the researcher, outlining why this field of study first sparked interest in the researcher, as well as how the study will impact the researcher's own personal work. The topical research provides an overview of the topics that emerged throughout the literature review and shaped the study. The theoretical framework focuses the research even

more providing a limit to the scope of the study. The purpose and research questions are closely intertwined with the theoretical framework.

Topical Research

According to Howley and Howley (2005) there is a need to develop "rural-responsive professional development" to meet the needs of rural educators (p. 3). Rural educators often have to hold multiple roles in their school and district to accomplish all the work required (Glover et al., 2016). Their PD needs may be learning content as they are being asked to teach outside their area of certification (Smith et al., 2013). A PD plan needs to be diverse enough to accomplish a variety of goals especially for elementary teachers who often teach more than one content area. Polly et al. (2014) found some positive results with providing elementary teachers with an intensive professional development program over thirteen months. The focus of the professional development was on instructional practices, mathematical beliefs, and mathematical content. The study had teachers receiving roughly 84 hours of professional development.

Elementary teachers can have a significant impact on students' beliefs around mathematics (Park et al., 2016). Rural schools have a limited pool of qualified applicants, the PD must be done with those teachers who are currently teaching mathematics to elementary students. Facing math scores that are below proficient for the majority of students (Maine Department of Education, 2020), there is a pressing need to examine how to best support elementary math teachers' instruction. This includes determining why some classrooms appear to have more engagement in mathematics than others.

According to Smith et al. (2013), one way to improve mathematics instruction in rural classrooms is to provide high-quality PD experiences for the teachers already employed by the rural district. Another study showed PD aimed at helping elementary teachers understand the

neuroscience behind learning mathematics in conjunction with understanding mindset theory does have a positive impact on student achievement (Anderson et al., 2018). This study examined how PD experiences focused on math content impacted teacher efficacy. The study collected qualitative data from classroom observations and teacher interviews to gain understanding of teacher efficacy and beliefs around mathematics instruction.

The first topic explored in the literature review was PD for teachers. There are specific characteristics of high-quality PD. In fact, the United States Department of Education in its non-regulatory guidance for Title II Part A (2016) discusses the components of PD for teachers. It states the "activities are sustained (not stand-alone, 1-day, or short-term workshops), intensive, collaborative, job-embedded, data-driven, and classroom-focused" (p. 11). These qualities within a coherent system increase the likelihood of PD having a positive impact on student achievement (Kyoung-oh et al., 2018). A coherent system is one that builds on prior knowledge of teachers and links to school and district goals. Even with the best system created and the best PD plan developed, a critical factor is a teacher who is implementing the change. Teachers must believe the change is feasible and will produce tangible results (DuFour & Fullan, 2013). This belief will have a strong impact on whether the PD produces any results in the classroom.

In 2007, Dweck defined mindset as a set of beliefs people have about intelligence. Dweck (2007) discussed how many successful individuals have a growth mindset that recognizes failure as a part of learning. People who demonstrate a growth mindset work through more challenging problems due to their understanding that intelligence is not fixed. Individuals with growth mindset attitudes believe challenging situations or difficult learning experiences are a part of the process of achieving success (Dweck, 2007). Growth mindsets are in contrast to fixed mindsets, where individuals look at challenges as demonstrations of not being smart or capable,

which can be debilitating in a classroom. Boaler (2016) took the work of Dweck and expanded it to address mathematical mindsets. Boaler looked at the neuroscience behind how people learn math and coupled it with the mindset knowledge gained from Dweck's work. Boaler (2016) found students at an early age have the ability to think mathematically and understand mathematical concepts. She argues that when elementary teachers use procedural mathematics to teach algorithms to students at an early age, they begin to develop a fixed mathematical mindset in students. Boaler (2016) states that all math teachers (elementary and secondary) must believe that all students can be successful mathematicians. This belief will foster creative problem solving and allow for divergent mathematical thinking instead of emphasizing basic procedural knowledge for a select group. As students can develop strong ideas about their abilities by as early as first grade, those who believe they cannot do math will need to be convinced otherwise. Students develop math anxiety that impacts their overall math performance (José et al., 2017).

Efficacy is a teacher's confidence in their ability to achieve success in the classroom. Teachers with a high efficacy hold a confidence that they will help the students in the classroom be successful (Donohoo, 2017). These teachers are more willing to take risks, push students to go deeper in their understanding, and will problem solve with others to persist through challenges. Those with a low efficacy are less likely to try innovative approaches to teaching or to even push their students to move deeper beyond surface learning (Bandura, 1997; Bray-Clay & Bates, 2003; Katz & Stupel, 2016).

Theoretical Framework

Roberts and Hyatt (2019) state that a theoretical framework in a qualitative study allows the researcher to focus the scope of the study. The theoretical framework underpinning this

study was based on the theory of teacher self-efficacy. Efficacy was first introduced by Bandura (1986) as part of a social-cognitive theory. Bandura (1997) explained self-efficacy as a person's belief in his/her ability to reach goals and impact change in life. Teacher efficacy is the belief a teacher has that they can make an impact on the students in the classroom (Katz & Stupel, 2015). Teachers with a strong efficacy believe in their ability to provide quality instruction that will impact a child's trajectory in life and ability to understand a specific concept or skill in the moment. Teacher efficacy has been shown to have an impact on instructional practices within the classroom that can impact student learning. Kunsting et al. (2016) also found teacher efficacy to be "a long-term predictor of instructional quality" (p. 299) and found it to be relatively stable over a period of six to seven years. Teacher efficacy can impact instruction as a higher efficacy builds confidence in instructional ability (Gonzalez & Maxwell, 2018). As teaching is a personal endeavor, the way a teacher feels about mathematics can impact how it is taught in the classroom. Teacher efficacy will provide a viewpoint for examining this study and the data collected.

Elementary Math Teachers

Elementary mathematics teachers in the United States do not usually have a strong math content knowledge background (Reid & Reid, 2017). Through federal and state requirements of certification there is a desire to create a minimal threshold of math knowledge elementary teachers should have, but it varies greatly amongst states (National Mathematics Advisory Panel, 2008). In order to be a highly-qualified mathematics teacher, some states require teachers to take a standardized test to show understanding or allow them to accumulate course credits in math courses to achieve the needed course requirements during their undergraduate program.

For those elementary teachers currently in the field, one way to improve mathematics understanding is through high-quality PD opportunities. Teachers who have a mindset of continuous learning and who participate actively in PD can have a positive impact on student achievement (Moore, 2009). Liang et al. (2015) found a positive association between teachers who participated in PD and student achievement after examining teachers' self-reports of PD participation with the 4th and 8th grade achievement results in the Trends in International Mathematics and Science Study (TIMSS). Elementary mathematics teachers need to have opportunities to participate in high-quality PD. Unfortunately, not all PD activities are created equal and do not always equate to improving student achievement.

When examining state achievement tests, some studies have found that even though the teachers participating considered the PD a success, there was no positive impact on student achievement and sometimes even a negative impact was reported (Killion, 2017; Polly et al., 2018). Often the effectiveness of PD is measured by teacher surveys of how well they enjoyed it, if teachers will implement something they learned, or even by a percentage of participating teachers. Some teachers report the PD had a positive impact on student learning without a reference to a specific student achievement test (Althauser, 2015; Foster et al., 2013; Gissy, 2010; Killion, 2015; Martin et al., 2018).

When the impact of PD is determined through teacher surveys, and not through actual achievement data, there can be a disconnect to whether or not the professional development is delivering results that directly or indirectly impact student achievement. The literature seems to vary on the effectiveness of different professional development aimed at a specific group of teachers or content areas, although there is a growing body of evidence of the features of effective professional development (Gulamhussein, 2013). Foster et al. (2013) found providing

teachers with opportunities to gain a better understanding of specific math content knowledge, as well as university partners to support the new instruction had success with middle school math teachers but did not work with elementary school teachers or in science. Student achievement scores on a state assessment test were used as the measure of effectiveness in this study. With the varying models of professional development having success in actually improving student achievement, it is essential to explore the qualities of professional development models that have shown to be effective.

Qualities of Professional Development Models

There are a variety of definitions for what classifies effective professional development for teachers, yet there are some characteristics that have been agreed upon as elements of high quality professional development. The characteristics defined by United States Department of Education (2016) are commonly thought of as the core requirements for high-quality PD. These characteristics can be further explored based on the literature to find models that clearly define them.

Sustained and Intensive PD

Professional development should be sustained over a substantial amount of time and rarely should be a one-day or half-day workshop that is never revisited again (United States Department of Education, 2016). The most effective professional development experiences span over a year or more and usually include follow-up support as teachers implement new strategies or knowledge (Althauser, 2015; Breyfogle & Spotts, 2011; Yoon et al., 2007). An outside observer visiting a classroom and providing feedback directly to the teacher could provide follow-up support. Scheduled time for teachers to meet with coaches or administrators after

implementing a new tool or strategy to reflect and process is another strategy that has been shown to be successful (Killion, 2017).

When providing sustained professional development, it is important to focus on specific skills and knowledge that can be implemented by the teachers in the classroom. As the implementation occurs and teachers feel successful in implementing the strategy, they will be more apt to continue to work to improve instruction. Polly et al. (2014) studied a group of elementary math teachers over an eighteen-month period where they were provided specific math instruction to build their math knowledge while also learning about how to improve their questioning techniques in the classroom. Teachers were observed and completed surveys on their own beliefs about mathematics. They also participated in reflective discussions sharing their learning. The sustained project showed beliefs changed around how best to teach mathematics, as well as a change in instructional practices to match the new understanding. The change occurred because the providers of professional development periodically adjusted the content and delivery of the tasks to match the readiness of the teachers to implement.

Collaborative PD

Teaching can sometimes be an isolating profession, especially for elementary teachers who teach the same group of students all day or for teachers who are the only one who teaches their content or course in the building. Elementary teachers will often share they barely have time in the day to go to the bathroom, much less collaborate and reflect with other teachers in their building. Richard DuFour (2004, 2013, 2016) promoted the implementation of professional learning communities (PLC's) in school districts to create collaboration amongst staff. Embedded in the philosophy behind using a PLC structure is a shift of discussion from what is being taught to what is being learned (DuFour, 2004, 2013). This shift creates a change in the

collaborative nature of the teacher teams and professional development. “Teachers work in teams, engaging in an ongoing cycle of questions that promote deep team learning” (DuFour, 2004, p. 8). As this cycle of deep team learning evolves, relationships within the PLC strengthen. Meaningful relationships in professional development have a positive impact on teachers' abilities to implement an inquiry-based approach to teaching (Green & Kent, 2016).

Professional development and learning experiences need to provide opportunities for purposeful collaboration. With new resources in technologies, it does not always have to be in-person, face-to-face discussions. There has been success using online digital forums with asynchronous learning or even virtual discussion groups to provide an opportunity to collaborate with others. Francis and Jacobsen (2013) studied a group of elementary math teachers who worked together on online mathematical tasks and shared through online discussion boards their insights and ideas. They found the quality of discussion was enhanced when the tasks were meaningful to the teachers.

Adult learners need to have opportunities to have reflective dialogue around their learning experiences (Green & Kent, 2016). Teachers shared that sustained professional development that improved collaboration and collegiality was an important factor to them in the successful implementation of new learning (Green & Kent, 2016; Moore, 2009; Smith, 2017; Wilson et al., 2017). The dialogue can be facilitated by a teacher leader, administrator, or outside consultant, but must be a person who is trusted and respected by teachers. Teachers will not openly discuss concerns or failures that happen in the classroom if there is not a feeling of trust and support amongst the group. Generating trust through opportunities for collaboration is another reason for sustained professional development.

Teachers need to be encouraged to share critical feedback with peers in a constructive manner. Abrams (2009) suggests most educators have a desire "nurture others" (p. 8) which can sometimes get in the way of providing clear, collaborative feedback to others when needed. Teachers will tend to be silent waiting for someone else to address an issue, instead of speaking up even if it is getting in the way of improving student achievement. When working to develop collaborative professional development, there needs to be time to build a framework for having difficult conversations that bring about actual change within a school or system (Abrams, 2009).

Job-Embedded and Classroom-Focused PD

Professional development experiences focused on an immediate classroom need were viewed more favorably than those that did not have a direct correlation to work being done in the classroom (Gissy, 2010). Using information gained from classroom observations and conversations with teachers about their needs for improving instruction could be used to craft professional development experiences that directly linked to classroom need. When teachers have a voice in determining the focus of their professional development and can actually see how it will impact their students, it is viewed as more effective (Beavers, 2009; Casale, 2011).

When classroom observations and reflective conferences occur with teachers around how the learning has impacted the classroom, it is more likely to bring about a change in practice. Teachers are more likely to support their colleagues as they implement the new strategies if they have had prior experience in their own classrooms. They will share successes and failures, as well as resources to make implementation more successful (Sun et al., 2013).

Data-Driven PD

Foster et al. (2013) found providing teachers with more content knowledge does not necessarily mean an improvement in student achievement. There is sometimes an assumption

made that by providing teachers with PD that has the key components listed above, it will automatically result in higher levels of student achievement. Garet et al., (2016) found even though teachers' math content knowledge improved and teacher participation was high, there was no significant impact on student achievement from a professional development opportunity providing over eighty hours of PD to teachers. Administrators and teachers need to use quantitative and qualitative data to determine the PD needs of staff and to determine if the PD is effective (McGee, Wang, & Drew, 2013).

PD needs to be sustained, intensive, collaborative, job-embedded, classroom-focused, and data-driven (United States Department of Education, 2016). These qualities, within a coherent system, increase the likelihood of it having a positive impact on student achievement. A coherent system is defined as one that builds on prior knowledge of teachers and links to school and district goals. Even with the best system created and the best PD plan developed, a critical factor is the teacher who is implementing the change. Teachers must believe the change is feasible and will produce tangible results (DuFour & Fullan, 2013). This belief will have a strong impact on whether PD produces any results in the classroom.

Teacher Efficacy and Mathematical Beliefs

Efficacy is a teacher's confidence in his/her ability to achieve success in the classroom. Teachers with a high efficacy hold a confidence that they will help the students in the classroom be successful. Those with a low efficacy are less likely to try innovative approaches to teaching or to even push their students to move deeper beyond surface learning (Bray-Clay & Bates, 2003). Teacher efficacy has been shown to have a direct impact on student achievement both as individual efficacy and collective efficacy (Donohoo, 2017; Hattie, 2012).

Teacher efficacy can have an impact on how a teacher implements what is learned in professional development. Harbin and Newton (2013) found there was little connection between classroom practice and the teachers' spoken beliefs about mathematics as related to the pre-service instruction. The most powerful influence was the teacher's own mathematical experience. Bray-Clay and Bates (2003) state, "the link between personal agency and a teacher's efficacy beliefs lies in personal experience and a teacher's ability to reflect on that experience and make decisions about future courses of action" (p. 14). This means prior negative experiences with math impact the teacher's efficacy about their ability to teach math. There are ways to build teacher efficacy and therefore combat against how a negative prior experience in math could inadvertently negatively impact student achievement.

One way to build efficacy is to provide PD opportunities focused on pedagogy and content together with on-going coaching. These types of quality PD have been shown to build teacher confidence (Green & Kent, 2016). Yoo (2016) found that teachers who participated in an online opportunity for PD and were asked to reflect on their self-efficacy throughout the experience reported having an increase in their own self-efficacy through the online PD experience. The study was over a five-week period but findings showed how online learning can increase teacher confidence in their ability to move the needle on student achievement.

Another way to build self-efficacy is through enactive mastery. Enactive mastery allows a teacher to experience and practice skills and knowledge over time before being expected to implement something in a classroom with students (Bray-Clay & Bates, 2003). An example of this would be to use the framework for assessing a teacher's mathematical knowledge developed by Selling, Garcia, and Ball (2016). Teachers could do a self-assessment before beginning a learning experience, as well as at the end of the experience. They could then see how their

understanding of the content grew and would potentially find an increase in efficacy with the new knowledge and skills, as efficacy has been shown to increase when a person's belief in their own understanding increases as well. According to DuFour and Fullan (2013), "nothing succeeds like success" (p. 75). The expectation of success from having prior successful experiences will cause teachers to "expend extra effort for longer periods of time when faced with a challenge" (DuFour & Fullan, 2013, p. 75). As self-efficacy about one's ability to positively impact a student's mathematical achievement improves, classroom instruction will shift to match the desired outcome as well.

There is also a focus on the collective efficacy of a staff in a school to impact student achievement. Collective efficacy is the self-perception that teachers in a given school, as a whole, make an educational difference to their students over and above the educational impact of their homes and communities (Tschannen-Moran & Barr, 2004). In other words, a school staff or team believe they can make a change in every student's educational career just by having them present in the building to learn. Tschannen-Moran and Barr (2004) found a significant positive relationship between collective efficacy and grade 8 writing, math, and English scores in a study examining middle school students in Virginia. According to Donohoo (2017), collective efficacy has a greater impact on student achievement than home environment and parent involvement. A meta-analysis research study done by Eells (2011) as cited in Donohoo (2017) showed that student achievement and collective efficacy were strongly related. If collective efficacy can have such a positive effect on achievement, professional development needs to focus on providing the opportunity for colleagues to dialogue, learn, and grow together.

The Emotional Component of Learning

Understanding how the brain develops and learns is critical to knowing how to best achieve success in students (Dubinsky et al., 2013). Boaler (2016) discusses how mathematics teachers need to unleash the creative side of mathematics for students by sharing open-ended tasks to complete. These tasks are more about conceptual understanding than procedural understanding. Math instruction needs to include both procedural and content knowledge, but teachers must have a deep mathematical understanding to teach both well (Reid & Reid, 2017). If provided opportunities to watch others teach in a manner that allows for creativity and problem-solving with opportunities to ask questions about why instructional decisions were made, teachers will be more likely to adopt those same types of experiences in their own classrooms (Polly et al., 2014).

Mathematics is sometimes viewed as a discipline in which answers are either right or wrong. Teachers may provide instruction that creates an atmosphere for learners that they are either good at math or they are bad at math. Boaler (2016) suggests providing students with a different view of mathematics that allows teachers and students to understand how mathematical mindsets can be developed as they learn to use strategies such as number talks and data dialogues to fully understand mathematical concepts. Realizing how the brain grows and develops as it learns new things creates an opportunity to teach students to persist through challenges. Teachers can model mathematical thinking focused on persisting through problems (Boaler, 2016). Modeling appropriate mindsets is vital considering the study done by Beilock et al. (2010) that found, when female elementary math teachers had anxiety about math, there was a negative relation on the student achievement data of the female students in the classroom. The boys did not seem as affected, but after a year of instruction, the higher the math anxiety of the

teacher, the greater relational impact it had on the girls' math achievement (Beilock et al., 2010). As teachers are working to improve mathematics instruction, they must look at their own emotional ties to mathematics as well as their students' beliefs.

A major factor in mathematics instruction can be identifying and overcoming math anxiety in young children. Feifer (2017) explained how a study by Young, et al. (2012) examined how math anxiety impacted young children. The study showed those students with high math anxiety also demonstrated an overactive amygdala in a region commonly associated with learned fears. The other important component of the study showed these same children also had a less active prefrontal cortex, the part of the brain that supports working memory and attention. In comparison to those with a low math anxiety, these students were already facing an actual physical disadvantage with just being told they were going to do math. There are tremendous implications for elementary teachers who must work with those students to overcome those learned fears. If the teachers themselves have a math anxiety, it creates an even greater barrier for student achievement (Beilock et al., 2010). Professional development activities for elementary mathematics teachers must address this new understanding of how anxiety and other emotional components could impact mathematics achievement in their students.

In a study by Clarke et al. (2014), they found providing teachers with complex mathematical tasks to persist through allowed them to share a similar experience with what their students were experiencing as they persisted through challenges. Teacher efficacy improved, as well as improving teacher decisions in the moment instruction happened to improve student mathematical understanding. For those teachers who might have math anxiety themselves, this type of "safe" learning environment can work to undo the learned fear of mathematics. The

more success a teacher has in understanding a concept, the more likely they will be to teach the depth of the concept to students instead of only focusing on the basic procedure embedded within a task (Clark et al., 2014).

Learning is a social and emotional endeavor. Both the teacher and the student are in a delicate balance between pushing beyond what is already known to something yet to be learned. By teaching educators how the brain develops and how emotions impact learning through actual brain dynamics, they can better prepare themselves to create a classroom atmosphere conducive to learning. The studies on how teaching elementary students about the power of yet and the acceptance of failure as being part of learning show a positive relationship on student achievement in the classroom (Boaler, 2016; Duckworth, 2016). Students can recognize that learning is hard and takes time, but the teacher is there to provide support and encouragement to work through it.

The literature around teacher efficacy, brain development, and the emotional component of teaching and learning mathematics provides a unique framework for examining PD experiences. Boaler (2016) encourages all math teachers to "encourage students to think deeply about mathematics" (p. 103). If a teacher does not feel adequately equipped in his/her own understanding, will they be willing to move beyond superficial learning? Does a teacher have to have a certain level of efficacy to feel confident in his/her ability to teach mathematics content? As educators work to improve elementary mathematics education, it is important to examine teacher efficacy and the emotional ties to mathematics teaching and learning.

Conclusion

Elementary mathematics teachers are often generalists, as they teach more than one subject area in most schools (Association of Mathematics Teacher Educators, 2013). They can

have various levels of mathematics knowledge and instructional practices that work best for teaching elementary math concepts to students. They may even have their own negative experiences with math that create a barrier for quality instruction. By examining the qualities of professional development that have been shown to raise levels of student achievement, it may provide insight in ways to build a professional development program to have a positive impact in elementary mathematics classrooms.

Providing teachers with collaborative opportunities to work through the content and persist through challenges, much in the same way their students will, has been shown to have positive results with changing teacher instructional practices (Clarke et al., 2014). Could this model be replicated for elementary teachers in rural schools? If so, should the model include providing math coaching to those teachers from an outside expert or from a trusted colleague? Are there things leaders within a school can do to facilitate stronger mathematical mindsets for teachers and thus for students as well?

The literature provides a strong base for understanding the key components of professional development. There is a lack of research focused on how rural leaders can use professional development geared towards elementary math teachers' self-efficacy and mathematical mindset to impact instructional practices. Determining a model for success that can be duplicated across multiple sites would provide valuable insight for schools and districts to use in a school improvement plan.

CHAPTER THREE

METHODOLOGY

The quality of teacher instruction in a classroom is the greatest influence on student achievement that schools can control (Opper, 2019). Professional development (PD) experiences for teachers are provided to help improve instructional practice. The United States Department of Education non-regulatory guidance for Title II Part A (2016) provides a description of the characteristics of high-quality professional development. Yet, some PD experiences do little to change a teacher's practice in the classroom (Guskey, 2002). This qualitative study sought to understand PD experiences from elementary teachers' perspectives. It used a descriptive case study methodology for understanding elementary teachers' math PD experiences in a public school district in New England. A descriptive case study describes the phenomenon and the context in which it happens (Yin, 2018). Specifically, this study examined how mathematical PD experiences influenced instruction and the teachers' feelings about teaching mathematics.

Purpose of the Study

The purpose of this descriptive case study was to understand PD experiences from the viewpoint of the elementary teachers involved, specifically the ways the PD experiences impact teacher efficacy and beliefs around mathematics instruction and learning. Elementary teachers often lack a strong mathematics background (Association of Mathematics Teacher Educators, 2013). Even those with strong mathematics background can sometimes struggle to model elementary math concepts (Holm & Kajander, 2019). Elementary teachers have a low self-efficacy related to math, as well as having math anxiety around teaching concepts to elementary students (Beilock et al., 2010; Hadley & Doward, 2011). Although PD experiences are designed to support math instruction, they have varying amounts of success. The researcher examined

how PD experiences influenced elementary teachers' beliefs about mathematics instruction and their teacher efficacy in regard to mathematics. Teacher efficacy is determined in two specific areas: teachers' beliefs in their own abilities to teach mathematics and teachers' beliefs about their ability to influence their students' achievement in mathematics.

The purpose of this descriptive case study was to specifically examine the intersection of rural elementary educators' feelings about mathematics during a PD experience and their implementation of learned concepts into their instruction. According to Bloomberg and Volpe (2019), a descriptive case study is "used to describe an intervention or phenomenon and the real-life context in which it occurred" (p. 50). A case study is suitable when the researcher is studying a contemporary event, he/she has little or no control over (Yin, 2018). As the professional development experience was implemented during the case study, it provided valuable insight into the experience. Participants also shared valuable data about prior mathematical experiences throughout the semi-structured interviews. The information gained can inform how future PD experiences are designed and provide needed insights into ways to support high quality math instruction. With only 12% of Maine schools having 3rd through 8th grade students meeting benchmarks on the state assessment in 2018-19 (Maine Department of Education Data Dashboard, 2020), it is critical that mathematics instruction and professional development be examined and improved.

Research Questions and Design

According to Yin (2012), when the desire of the researcher is to understand the how and why behind a situation, a case study is an appropriate methodology. The overall research questions for this study were:

RQ_1: How do PD experiences impact rural elementary teachers' beliefs about their abilities to teach mathematics?

RQ_2: How do PD experiences impact rural elementary teachers' efficacy in regards to mathematics instruction?

RQ_3: How do rural elementary teachers describe how PD impacts their perception of mathematics instruction?

These questions were focused on the PD experience from the teachers' perspectives, as well as the internal beliefs around math that a teacher may hold. A descriptive case study methodology was required to understand the experience from the teachers' own words and viewpoints. The goal was not to quantify the experience with statistical analysis, but to understand and grasp the how and why from those who directly participated in the PD. A case study allows the researcher to have an in-depth understanding through interviews, observations, artifacts, and other relevant data of the case (Bloomberg & Volpe, 2019). The case study occurred in one school district with elementary teachers who teach math from kindergarten through 5th grade, drawing data from a PD experience. The researcher used three different types of data for the case study: interviews, observations, and artifacts. There were two rounds of semi-structured interviews with each teacher. The interviews lasted between forty-five and ninety minutes depending on how much the participant wanted to share. Each teacher was observed once between each interview. The artifacts reviewed were notes from the PD experience, minutes from meetings between teachers who participated in the PD, and classroom artifacts, such as sanitized student work, that provided an understanding on classroom instructional practices that were implemented or adjusted due to the PD experience and provided data for research question two.

Site Information

The district setting in which the research was conducted had a mathematics PD start in the summer and continued in the fall, and was focused on the goal of raising the mathematics achievement of students. The researcher was a district administrator yet did not directly supervise any teachers. The study examined teachers' experience during the professional development, the classroom implementation, and the teachers' self-efficacy around mathematics, as teacher self-efficacy is a contributing factor to student achievement in elementary mathematics classrooms (Bray-Clay & Bates, 2003; Harbin & Newton, 2013; Yoo, 2016). The elementary staff is split between two buildings with K-3rd grade in one building and grades 4 and 5 in the middle level building with grades 6-8. All teachers were within a few miles of each other and have varying levels of experience from five years of teaching to over 20 years.

The researcher's role in the district and relationship with the staff allowed access throughout this research study to do an in-depth analysis of the professional development experience. The researcher has built a level of trust, so staff regularly share concerns and suggestions for improving activities within the district. As this was a more in-depth discussion, the researcher worked to continue the relationship building and was cognizant of the impact the pandemic situation on staff. The participants willingly provided her with more information outside of the normal feedback provided. A bracketing journal was kept throughout the research process to document any research bias throughout the study.

There were roughly 16 teachers in grades K-5 participated in the PD experiences. After obtaining site permission to conduct the study (Appendix A), an email was sent out asking for willing participants (Appendix B). Only eight of the 16 teachers who participated in the PD volunteered to participate in the study.

Sampling Method

Two-tier sampling is a method of sampling utilized when a specific case is first chosen to be studied and then there is a sampling of people within the case who are chosen to participate (Merriam & Tisdell, 2016). This method of sampling was not required in this case study as only eight of the teachers in the district wanted to participate. As this researcher wanted to understand rural elementary math teachers during a PD experience, all participants were eligible to participate. The first tier of sampling was to determine the case site for the study. The case site was chosen based on it being a rural district with access to elementary teachers who had recently participated in a mathematics PD experience.

For the second-tier of sampling, teachers were asked to voluntarily choose to participate in the research study. There were no qualifications based on years of teaching experience, as the case study was not related to how long someone has taught. Teachers who participated were asked some basic background questions related to their teaching experience and educational preparation prior to participating in the study. They were also be reminded they could choose to not participate at any time during the study.

The research questions were focused on what impact, if any, the PD experiences had on elementary teachers and math instruction. The participants spanned the K-5 teaching body which provided a broader perspective using a stratified sampling. One reason for this selection was many teachers have a grade-level team with whom they interact with frequently. This group has shared decision-making processes and often have developed a common language and instructional practice. In some instances, the team had been together for so long their common thought process could have caused a perceived saturation when it was just common perspectives. By interviewing across grade levels, it took longer to reach saturation of data. Yet, the data

contained multiple perspectives of many PD experiences, as the participants divulged information about previous PD experiences from as far back as their student teaching.

Instrumentation and Pre-Study Protocol

As the primary data collection was participant interviews, it was critical to establish the questions for the semi-structured interviews to be sub-questions of the main research questions. Creswell (2013) suggests having five to seven open-ended questions written as an interview protocol. An interview process was essential, as the researcher wanted to understand the teachers' own perceptions about the PD experience as well as their feelings around mathematics. As the heart of the study was how the teachers' feelings about mathematics may or may not change in response to PD, a semi-structured approach allowed the "researcher to respond to the situation at hand" (Merriam & Tisdell, 2016, p. 111). This was important when addressing a topic that may be uncomfortable for a teacher or require a teacher to be reflective of their own mathematical experiences and the implications on their teaching practices.

The questions in the semi-structured interview were piloted and shared with experts, who were not part of the study, to determine if they were worded in a way the interviewee could understand, as well as determining if the questions arrived at the type of answers needed for in-depth analysis. The semi-structured interview questions were the protocol for each interview (Appendix D). Piloting questions is important, as Creswell (2013) states that a case study can be too bounded and not provide the type of in-depth analysis needed for a research study. Reviewing the questions was an essential component prior to the study.

Classroom observations focused on teacher moves during the classroom instruction related to information gained from the PD experience or information shared in the first interview. For example, if a tool focused on math discourse was taught in the PD session providing prompts

to use for mathematical discourse, the researcher observed instances when those prompts were used in the classroom. This required the researcher to attend the PD sessions and to access the notes from the sessions after they occurred to be able to determine what new learning occurred that was employed during the observation. These tools were reviewed by the teacher and researcher prior to the observation and after the observation to determine if they were an accurate depiction of what occurred during the observation. Conducting classroom observations was important as they provided evidence beyond the interviews as part of a multiple methods triangulation approach (Merriam & Tisdell, 2016).

Permission from the participants was requested to observe the classroom in the initial agreement outlining the expectations of being research participants (Appendix C). They could choose to not participate at any time. The researcher followed the district policy of observations done for research purposes. The focus of the observations was solely on teacher instructional moves and decisions, not on students. Merriam and Tisdell (2016) suggest that an outsider will notice things that have become routine to the participant. Classroom teachers may adjust their instruction without even realizing they have made a change, as it just becomes another tool they use for engaging students. Observations helped to provide context that was used to guide future interviews. The researcher gained district approval prior to any classroom observations of teachers and used a standard observation protocol.

Data Collection

According to Yin (2018) it is important to have multiple sources of evidence in a case study to triangulate data points. In fact, a case study is deemed higher quality when it uses multiple sources of evidence to gain an in-depth understanding of the phenomenon (Yin, 2018). The primary method of data collection was through interviews and artifacts from teacher

meetings with their teams. A secondary method was through observational data of classroom instruction with the teachers. The purpose of the observations was to generate a deeper understanding of how a teacher may have used purposeful decisions in instructional strategies or tools based on their teacher efficacy. A third set of documentation was artifacts such as exit slips of the PD sessions, notes of group discussions during the professional development, and sanitized student work samples to show evidence for research question two.

There were multiple PD sessions for each teacher to attend. After participants were selected, they were interviewed after the PD sessions occurred. This first interview was to gain trust, gather a sense of the teacher's feelings around mathematics, and determine their initial feelings about participating in the PD experience. The observation protocol was also shared to help the teachers understand the purpose of the classroom observation. The same teachers were interviewed again after having done a classroom observation using the research protocol within a week of the observation. Each participant was interviewed twice for a period of ranging from 45 minutes to 90 minutes each session. All the interviews were semi-structured. They were recorded and transcribed after the interview. The transcription occurred within a week of the interview. Each was transcribed verbatim and any names or identifying information was coded to protect the confidentiality of participants and school.

Data Analysis

The inductive, inquiry nature of the case study requires the researcher adapt to the information provided (Yin, 2018). The interviews were recorded and then scripted for review purposes. Participants were asked to complete a transcript review to be sure the transcript notes aligned to the recollection of the participants. The goal was to accurately capture the intent of the interviewee, not just write verbatim what they said in the interview (Creswell, 2013). The

interviews were coded through an inductive coding process framed within the research questions that allowed categories to emerge. Merriam and Tisdell (2016) suggest that categories should be exhaustive, mutually exclusive, and conceptually congruent. As these categories developed, they were revisited as more interviews and more data were collected. Yin (2018) describes this type of analysis as an inductive approach to understanding the data. Although the theoretical framework around teacher efficacy was critical to developing the research questions in this study and informed the data analysis, it did not pre-determine the categories. The categories emerged as more interviews were conducted and reviewed in conjunction with the classroom observation data and other meeting artifacts. The researcher went through the coding process with the transcribed interviews multiple times throughout to determine if there was drift that occurred within the coding process so it could be addressed in the analysis process.

The observation data and artifact data were used to triangulate with the interview data throughout the process. The triangulation was the use of multiple methods of data collection such as using classroom observations with semi-structured interviews to check against the documentation shared in team minutes (Merriam & Tisdell, 2016). As the data began to show a saturation point (Merriam & Tisdell, 2016), themes emerged based on the data gleaned from the study. Those themes were shared with some qualitative statements shared by participants to show samples of how they were derived and determined in Chapter 4.

The goal of the data analysis was three-fold. The first goal was to gather an in-depth understanding of how PD experiences impact rural elementary teachers' beliefs in their abilities to teach mathematics. The second goal was to understand how PD impacts teacher efficacy in mathematics. The third was to determine how PD experiences influenced teachers' views of quality math instruction. The three-fold examination provided "thick, rich description" of the

PD experience (Bloomberg & Volpe, 2019, p. 51). The analysis of teachers' perceptions provided essential information moving forward with mathematics PD.

Limitations

As with any qualitative study, the purpose of this case study was to understand a PD experience from the viewpoint of the teachers involved in the experience. Findings may not be able to be generalized to a different setting (Merriam & Tisdell, 2016). This study was based on a small number of participants from one school district. The information gleaned from the study can inform future research on math PD experiences, as well as provided characteristics of PD that are meaningful to elementary teachers. The information learned could be transferable to other content areas when designing future PD experiences.

As a district administrator, the researcher had a vested interest in understanding PD experiences from the teachers' perspective as there is a desire to get them the highest quality experience while promoting improved classroom instruction. The information gained from this study will be used to continue to foster a cycle of improvement in work done throughout the district. No participants were paid for the work, as it was completely voluntary. The researcher does not supervise any of the teachers who participated in the study but does work with them on a regular basis. This allowed an atmosphere of trust for open conversations. As with any study reliant on interviews, the quality of responses was only as strong as the responses provided by the participants. At each interview, participants were reminded their responses were being used for a specific purpose and to respond as honestly and frankly as possible to inform the research and provide integrity to the study.

Yin (2018) states that ethical researchers "maintain a strong professional competence that includes keeping up with related research, ensuring accuracy, striving for credibility, and

understanding and divulging the needed methodological qualifiers and limitations to your work" (p. 97). Throughout this research process the researcher relied on critical colleagues and the dissertation panel to provide guidance and direction to be sure to follow the appropriate methodologies. The researcher's biases about mathematics instruction did not impact the understanding of the teachers' experience and their mathematical instruction. This bracketing was done by allowing contrary perspectives to be explored throughout the process. Contrary perspectives found through the literature review were shared and explored, as well as exploring those same perspectives when they arose during the research study.

The participants of the research study provided limitations as well. As all of them were from the same site, and they may have developed some inherent biases, beliefs, or culture around mathematics or PD that impacted their ideas or feelings shared about their experience. This was alleviated as the purpose of the study was to understand how the participants thoughts and ideas adapt based on PD experiences. By conducting an interview while participants were in the PD experience and allowing participants to share information beyond just the one PD experience, the researcher was able to have an accurate picture. Another component was the data were only as rich as the information shared by the participants. This means they needed to feel comfortable in answering the questions, as well as being probed to share more when the answer felt incomplete or needed clarity. During the interviews, it was apparent that all participants were extremely comfortable in sharing the information. Also, by having the opportunity to review the transcription of the interview, the participants were able to share if their ideas were accurately captured. Although they sometimes offered minor adjustments or comments to the transcription, participants never made any substantiative changes to the interview transcriptions.

Credibility and Transferability

This study engaged in understanding a PD experience from the perspectives of the teachers involved. The research questions were answered through multiple data collection methods including semi-structured interviews, exit slips, classroom observations, and meeting notes from teachers. This triangulation using multiple data sources provided a clearer understanding of the experience (Merriam & Tisdell, 2016). There was an opportunity for respondent validation after interviews to be sure the transcription and themes accurately represented the information shared (Yin, 2018). The researcher kept a journal detailing methods used and decision points as a tool for future reflection and understanding. All these procedural protocols provided validity throughout the qualitative research process.

A future study may be able to be conducted at another site using similar methods and questions to explain the experiences of another group of elementary math teachers. The results may be different, as every human experience is fluid and interpretation of the experience is unique. There may be some universal underpinnings that are similar amongst educators in a variety of settings.

Ethical Concerns

There were some ethical concerns that needed to be addressed in this study. The first concern was the privacy of those participating in the study as well as the site of the study. All participants needed to give informed consent to be part of the study, as well as following the district policy on conducting research. Participants were protected from harm, including protecting their confidentiality and privacy (Yin, 2018). All recorded interviews were kept on a digital drive that is password protected. Participants had the ability to review their interviews and the transcription to determine if their thoughts and ideas were accurately depicted. All

names and personally identifying information was excluded from the research or replaced with pseudonyms when needed. The interviews were recorded via Zoom because face-to-face interviews were not permitted. Transcripts were kept in a digital cloud file that was also protected.

Another ethical concern was to ensure that the researcher's role in the district would not jeopardize or impact a teacher who volunteered to participate. The researcher holds no supervisory role and did not share any information gained from the research with other administrators who do hold a supervisory role. Only if participants disclosed information that was illegal or unethical would it be shared with someone beyond the purpose of this research study and that was not the case.

Finally, for all the elementary math teachers participated in the PD experience, the participation of the research study was entirely voluntary. The amount of time and expectations of the research study was shared with all prior to them committing to be a volunteer for the study. No teacher was required or coerced to participate in the study.

Conclusion

This chapter explained the descriptive case study methodology of this research study. The study focused on understanding a group of elementary math teachers' PD experience. The overall research questions for this study were:

RQ_1: How do PD experiences impact rural elementary teachers' beliefs about their abilities to teach mathematics?

RQ_2: How do PD experiences impact rural elementary teachers' efficacy in regards to mathematics instruction?

RQ$_3$: How do rural elementary teachers describe how PD impacts their perception of mathematics instruction?

These questions were answered through analyzing data from semi-structured interviews, exit slips, classroom observations, and team meeting notes of teachers who volunteered to be participants in the study. The sample size of teachers was eight of the 16 teachers who are participated in the PD experience. These teachers were all from the same district and span from kindergarten to grade five. The study was focused on gaining a deeper understanding of how PD might change personal perceptions about content that is sometimes difficult for teachers. As researchers know teachers' perceptions about mathematics can have an impact on their students' achievement in mathematics, it is important to understand how a PD experience can impact those perceptions and beliefs (Heyder et al., 2020). The focus was not on student achievement but on the teachers themselves. By understanding how teachers' efficacy and instructional beliefs are affected by PD experiences, future PD experiences can leverage the information to support rural educators in high-quality mathematics instruction.

CHAPTER FOUR

RESULTS

Teachers have a direct impact on the students in their classroom (Hattie, 2012; Strong, 2018). Elementary educators often do not have a mathematics background (Association of Mathematics Teacher Educators, 2013) and can have anxiety around math or a lower self-efficacy in regard to teaching math to students (Beilock et al., 2010; Hadley & Doward, 2011). As rural school districts work with limited resources to support teachers, providing quality professional development (PD) experiences can be a key component to improving instruction (Glover et al., 2016). This qualitative study focused on the impact of professional development (PD) experiences on rural teachers' beliefs in their own abilities, their teacher efficacy, and their perceptions of mathematics instruction.

A descriptive case study provided insight into the participants' perspective on the professional development (PD) experience and its impact on mathematics teaching in the elementary classroom. The participants were eight elementary teachers in a rural school district who will be referred with pseudonyms throughout this chapter. Although the teachers were asked questions about their current PD experience in the semi-structured interviews (see Appendix C), they often disclosed insights about previous mathematics PD experiences that had also impacted their teaching or PD experiences that had no impact on their teaching. When those insights related to the research questions below, they were captured in the data analysis and findings.

RQ_1: How do PD experiences impact rural elementary teachers' beliefs about their abilities to teach mathematics?

RQ_2: How do PD experiences impact rural elementary teachers' efficacy in regard to mathematics instruction?

RQ_3: How do rural elementary teachers describe how PD impacts their perception of mathematics instruction?

This qualitative case study focused on a specific PD experiences, but throughout the interviews it was clear the teachers wanted to disclose information gained, positive or negative, from previous PD experiences as far back as their pre-service days. The researcher allowed participants to discuss as much or as little as they felt comfortable communicating in the interview. The depth of information provided led to a thorough amount of data for the researcher to analyze for themes in regard to the three research questions.

Analysis Method

The methodology outlined in Chapter 3 provided the guidelines for the data analysis process and determined the overall data presented in this chapter. The researcher conducted a first round of interviews, each lasting between forty to ninety minutes, with the eight elementary teachers. The length of the interview was determined by the amount of information a participant wanted to share. The interview questions had been first tested on some critical colleagues who were not in the study for feedback and review (Creswell, 2013). Appendix C provides the interview protocol and questions. The interviews were recorded, transcribed, and provided to each individual participant for member checking. The researcher then observed a math lesson of each participant and recorded teacher strategies used during the lesson. The second round of interviews were recorded, transcribed, and given for member checking. Participants were encouraged to bring any artifacts in the interviews they felt spoke to mathematics achievement or

to describe strategies learned during the PD experience. Participants shared a few clarifications in the member checking, although there were no substantiative changes made to the transcripts.

The researcher used an inductive coding process with multiple cycles of review. The first cycle of coding separated out demographic information and delineated responses based on the three research questions. If a response seemed to address more than one research question it was coded as such. After the first cycle of coding, a second cycle of coding was done to determine pattern codes to determine themes across participants' interviews. According to Saldana (2016), pattern codes identify emergent themes and allow the researcher to synthesize material into more meaningful information. These patterns were reviewed, and overall themes adjusted multiple times to capture common threads arising from each question. The researcher kept notes of the changes and reasoning for them.

Presentation of Results

The first interview began with collecting the background of participants, as well as building a foundation for the observation and second interview. There were eight participants who volunteered to participate in the study after an email was sent out for recruiting purposes (see Appendix B). Only eight teachers responded to the email to be in the study, so all those who volunteered to participate were included. Five of the teachers taught in kindergarten through grade two and three teachers taught in grade three through grade five. All the teachers had at least three years of teaching experience.

As this study is aimed at conveying the teacher's perspective of the PD experience, it is important to provide a little background on each participant, as well as some of their thoughts around mathematics teaching. A chart summarizing years of experience, grade span taught, and pseudonym can be found in Table 1 below.

Table 1

Participants in Study

Pseudonym	Years of Experience	Grade Span Taught
Sue	28	K-2
Ann	8	3-5
Claire	21	K-2
Kate	20	3-5
Lisa	5	K-2
Olivia	13	K-2
Hannah	32	3-5
Tara	12	K-2

Sue has been teaching for twenty-eight years in the kindergarten through grade 2 setting. Sue stated that what she loves most about teaching the youngest learners is allowing them to talk. She said, "As teachers we sometimes are so quick to want to get everyone's voice in the circle, that you let them start and then finish for them." Sue explained that over the years of teaching she has learned to stop and just listen.

Ann teaches in the grade three through five span and has been teaching for nine years. Eight of those years have been teaching math in the elementary school. Ann was a non-traditional college student who brought experiences from growing up in another country and their educational system with her to the teaching profession. She mentioned that one of her first

lessons as a teacher was how to turn the computer on, as she did not have experience using technology and she is currently providing online lessons during a pandemic.

Claire has been teaching for twenty-one years with eleven of them being math in the elementary setting. She started as a specialist teacher, moved to a literacy teacher, and then moved to a general education teacher responsible for all subjects with some of the youngest learners. Claire said she loves teaching the youngest learners as she can teach integrated units and use her background in all content areas.

Kate started in education as a paraprofessional and has been teaching math over twenty years primarily to students in grades three through five. Her philosophy on teaching math was to use manipulatives and games whenever possible to reinforce a skill. Kate said, "engagement motivates them." She currently works with some of the neediest math students in the elementary school.

Lisa was one of the newest teachers in the study. She has been teaching math in the elementary school for five years. Lisa disclosed that with younger learners she finds ways to constantly review what they have learned during their math stations while continuing to build on their knowledge. She started teaching as a substitute math teacher in the middle level and feels the greatest gift she can give her young learners is an enjoyment of math and willingness to persist through challenges.

Olivia has been teaching thirteen years in the K-2 setting. She explained that she got into teaching because even growing up she was helping her younger siblings and others with their homework. Her goal in math class is to provide opportunities for modeling and repeated practice of skills and knowledge. She wants her students to be able to share multiple ways to solve problems.

Hannah has only taught two years in this district but has the most experience of all the participants in the study with thirty-two years teaching math. She has taught math to grades five through eight and is currently teaching in the grade three through five grade span. Hannah said for students to understand math they have to experience it and "see how it works in the real world."

Tara has twelve years of teaching experience, all at the elementary level. She taught in fourth grade one year and then moved to teaching in the kindergarten through grade 2 span. Tara explained that her students learn math best by "hands on without question." Tara said she tries to provide them with many different types of counters and tools to represent numbers in different ways.

As part of gathering background knowledge of the participants, the researcher asked participants to respond to four statements from Dweck (2006, p. 12) on mindset. The information gained was to determine if the teachers had a tendency towards having a growth mindset or a fixed mindset. The results, found in Table 2, showed most of the participants had a growth mindset toward intelligence and learning which could be why they were willing to participate.

Table 2

Participants Responses to Mindset Statements (Dweck, 2006, p.12)

	Mostly Agree/Agree	Mostly Disagree/ Disagree
Your intelligence is something very basic about you that you can't change very much.	0	8
You can learn new things, but you really can't change how intelligent you are.	2	6

No matter how much intelligence you have, you can always change it quite a bit.	6	2
You can always substantially change how intelligent you are.	7	1

Through the background questions, participants were asked about their pre-service experience including how they felt it prepared them for teaching mathematics in an elementary school. A theme of not feeling prepared until they were actually able to teach in a classroom or observe other teachers, was prominent. Hannah was the only participant who disclosed that her pre-service experience prepared her for teaching math. She was originally going to be a secondary math teacher and had an opportunity to take math courses to gain an in-depth understanding of skills and concepts. In her field placements, she was placed in a middle level classroom and ended up securing a job in the lower grades. All the other participants were elementary education majors and described a different type of experience. Tara explained that "as far as classwork goes, I did not feel prepared at all." Tara, similar to the other seven participants, said it was not until she was student teaching and observing other teachers in the classroom that she was able to see strategies for explaining math concepts to students.

There were four participants who were paraprofessionals before becoming elementary math teachers. They revealed that those experiences allowed them to watch veteran teachers and ask questions prior to having their own classroom. Kate had been a paraprofessional in the elementary setting for over ten years. Kate stated when she finally received her degree and first teaching position, she "pulled a ton of that prior knowledge" from the strong veteran teachers she had the "privilege of learning from in their classroom." Olivia recounted an experience where she was able to provide individual tutoring to students under the direction of an experienced

teacher during her preservice as being one of the best opportunities in her undergraduate preparation for understanding how to teach math. Claire mentioned she was able to work in multiple school systems as a substitute before becoming a full-time teacher which allowed her to "work with different grade levels and see how the math curriculum was different in different grade levels and different districts." Claire said, "prior to PD opportunities in mathematics, the only training I had under my belt was from math methods courses in college." In her second year of teaching, she "definitely needed guidance with math instruction." Although indirectly related to the research question, this recurring theme of the need for pre-service teachers to have the ability to learn in the classroom while earning their education degree was so predominant throughout the interviews it could not be left out of the background information.

Research Question 1: How do PD experiences impact rural elementary teachers' beliefs about their abilities to teach mathematics?

All the teachers interviewed stated they felt confident in their ability to teach the mathematics content they were responsible for teaching, as well as feeling strong in their ability to motivate their students to do well in mathematics. Although some openly admitted they would not have the same answer if asked to teach math at a higher grade level or if asked the question earlier in their career. The participants explained that PD experiences have impacted their beliefs about their own abilities to teach mathematics. When asked about how PD impacted their own beliefs about their abilities to teach math, they revealed two common themes.

The first theme was talking to or observing their colleagues teaching was vital as a way to gain understanding of mathematic concepts. When time was built into PD that allowed them to grapple with the content alongside their colleagues, it was considered a successful experience. During the PD, it was important to have a dedicated time to share ideas and problem-solve how

to teach current units of instruction or a new strategy with their peers. Tara said they wanted to have the materials and be able to go through an activity just like the students would, so they could then problem-solve prior to teaching the lesson. Teachers valued this time that allowed them to share celebrations, as well as challenges. Ann described a PD session this way, "We are just sharing. One has tried this tool and describes how it went." She explained that during this year of the pandemic her team valued the time they had to just meet and talk about what was important to them. She said, "for one and a half hours we are talking about things that are important to teachers, it may or may not be important to math." She believed this was still critical as teachers were grappling with so many different issues and needed an opportunity to reflect.

In interviews, participants explained talking with colleagues about teaching was often overlooked in the regular day, even though they recognized it was where they sometimes learned the most. For example, Sue stated, "There is a lot of experience in this building, and we should be learning from each other too." Sue described that, even with over twenty years of experience, it was those conversations with peers that allowed her to try something new when she heard others' success. Tara portrayed her experience of having the opportunity to talk to other grade levels about how they structured their math classroom during a PD experience. "It was helpful talking to other grade levels seeing how they did it." Although she did not use the same content, she took their strategies for structuring the instruction time and adapted it for her students. Claire expressed a similar feeling when she discussed how, when during the PD teachers discussed their math standards across grade levels, it helped her to know what she was really responsible for teaching. Kyoung-oh et al. (2018) found collaborative dialogue amongst teachers as a key component of quality PD experiences.

All the participants interviewed described the experiences they had watching veteran teachers in the classroom were major impactors in how they taught mathematics. As mentioned previously, four participants began their educational careers as paraprofessionals who spent time in a variety of classrooms. Even after many years teaching, they stated those were some of the most valuable PD experiences as they watched and then asked teachers why they chose specific strategies or tools for teaching a concept. Kate identified specific veteran teachers who still impacted her classroom decisions after twenty years. Ann pointed out it was by watching other teachers that she realized some taught math in a completely different way, and it was working with students. She said she kept a note of those strategies to use if students were struggling in the future. The first theme revealed by participants was the importance of teachers sharing information with each other. These collegial conversations enhanced their individual confidence in their abilities to teach math concepts.

A second theme emerged that PD had the ability to positively or negatively impact how teachers felt about their own abilities to teach mathematics depending on how it was structured. For example, Lisa indicated after a PD session she felt it had not been worth her time to attend as the content provided was so far above her students that she knew she would never be able to use what was taught. She explained that she tried to find applications to her current unit of instruction but could not find a connection to what she was teaching. Due to this fact of not being able to apply what she had learned in her classroom, the session seemed like wasted time. Kate disclosed a similar frustration about a PD experience a few years prior that made her feel as if her students were behind or that her teaching was not adequate. Olivia explained that when the PD was too focused on mathematics theory without a practical strategy, it did not give her something to use with her students. She even stated, “I walked away discouraged thinking what

I was doing was wrong." These situations show that PD can have a negative impact on teachers' beliefs in their abilities if it causes them to doubt their abilities in the classroom.

On the other hand, participants revealed times when PD had generated a positive impact on their beliefs about their abilities. Kate discussed having to grapple with hard concepts allowed her to be a stronger teacher when she knew the concepts were related to content she was going to teach. She explained walking away from a PD experience feeling extremely tired as she was showing multiple ways to solve the same problem, yet excited knowing she now had information to help her students solve the problem in another way. Olivia said PD showed her there were many tools that could be "used to teach the same concept, many of which I would not have thought of on my own." By participating in the PD, Olivia explained that it allowed her to see even more possibilities. Lisa mentioned PD allows her to take things that she knows can be adapted in her classroom and use them immediately. She explained that she often uses trivia and scavenger hunts as methods for teaching math, these were strategies she learned in a math PD experience that she could adapt to her room. Kate explained a positive experience when teachers were asked often during a PD session how they arrived at an answer. She said it opened her eyes to "all the ways numbers could be broken down" and realized that she needed to provide those same opportunities for kids in her classroom to explain. Ann stated she learned how to allow students to explore numbers and determine a strategy in a PD which changed how she taught math. From these common experiences, participants were clear that PD had an ability to impact their own beliefs on mathematics instruction.

Research Question 2: How do PD experiences impact rural elementary teachers' efficacy in regards to mathematics instruction?

Teacher efficacy is the belief in what a teacher does in the classroom can have a positive impact on the students they are teaching (Bray-Clay & Bates, 2003). Participants explained having PD that made them excited about teaching mathematics or even teaching in general transferred to their students. Ann acknowledged that, when she learned about how celebrating mistakes and learning from mistakes in mathematics can create deeper learning experiences, she gave that information to her students. She explained her classroom changed from students wanting to always get the right answer to wanting to share mistakes and figuring out why someone made the mistake. Ann explained the impact would not have happened without participating in the PD. Hannah stated that PD gave her more confidence in trying new things with students. She explained that by "trying new things with students and seeing them succeed, makes me even more excited about trying new things." She elaborated with, "that is always why I am willing to try PD that comes my way that will benefit what I do in the classroom." Olivia described that the PD experience this fall "has made me confident that I am doing what is most effective for students." She explained that by trying a new strategy within her classroom and seeing students' ability to explain their thinking allowed her to adjust her instruction to make it more effective. Sue said for her student success was measured in her students' ability to see math outside the classroom and be excited for math class. She learned the phrase, "math is everywhere" in a PD and believes that when students describe where they saw math at home or choose to do math during free choice time, they have been positively impacted.

Three other teachers acknowledged they did not like math as a student, and it was through PD experiences during their teaching career that they were able to learn to enjoy math

and portray that enjoyment to students. Lisa stated, "your attitude about any subject is going to rub off on every single kid in your room." She explained she had always felt inadequate in the classroom as a student and was determined to not let any student feel the same way she did. Lisa described attending as many PD sessions as she could in her first years of teaching to learn different tools and strategies, so she could adapt them and use them in her classroom. She said, "I knew I had a lot to learn." Sue declared she would not let students know that she was not a strong student. Participants reported they purposefully build catch phrases and excitement into their math classroom based on their own experiences to make sure students leave loving math or believing they can be successful in mathematics. PD created excitement and confidence in teachers, thus creating a higher level of teacher efficacy around mathematics instruction was a recurring theme.

When participants were asked about their ability to improve students' mathematics achievement, they all said they felt they were able to improve achievement in their classroom. A couple of participants stated that PD experiences help them to find other ways to potentially explain a process or concept to the student who may not be as successful as others. A common theme that emerged was the realization all students may not be at exactly the place teachers want them to be at the end of the year. Participants seemed to accept this as a fact and as a challenge for finding different ways to teach a concept or motivate a student to want to learn a concept. Participants also mentioned that there are some years where students see more growth than in other years. Hannah said focusing on the growth that individual students make over the course of the year was an important factor for her to measure success. She stated, "not all kids will be where you want them, but all should have moved from where you started."

Research Question 3: How do rural elementary teachers describe how PD impacts their perception of mathematics instruction?

The participants in this study provided a variety of suggestions for how students best learn mathematics. Participants thought math was best learned through hands-on learning, modeling, discussions, real-life experiences, and repetitive practice with concepts or skills. Interestingly enough, when asked how they arrived at these ideas of how to teach mathematics, they related it to their own learning of mathematics as a student and/or a pre-service teacher, experiences watching other teachers, their own teaching experience, and PD experiences.

Participants disclosed PD experiences that were provided by people who were experts in mathematics had varying levels of success in changing their perception of mathematics instruction. Yet, when those experts provided tools or strategies that worked, then teachers were willing to implement other things learned in the PD. For example, Sue explained that when the expert provided a strategy such as using the phrase, "what did you notice" as part of a conclusion for a lesson, she immediately used the strategy in her classroom the next day with a feeling of success as students provided her answers that allowed them to understand their thinking. She went back to the PD ready to learn about another tool or strategy to use in her next unit or lesson. Yet, Lisa said when an expert provided a tool that was more time-consuming to create than the tool she normally used in her classroom instruction with success, she did not make a change. Hannah described her PD experience by saying "some of it works with some kids and some of it doesn't." She said the important thing is to be open-minded when attending a PD session and try to bring at least one tool or strategy back to use. Hannah explained that if it worked, she may use it again or may try another suggestion from the PD. Claire said "after attending the PD I was so motivated to implement my new learnings. The major reason being it aligned with my own

beliefs of teaching to the developmental needs of students." Participants divulged if the tool or strategy could be implemented easily without too much time required, they would try it. If they had success using it, they would continue to use it.

Another common theme that emerged was the PD had to be provided by someone who participants trusted to have experience or at least a vested interest in their success as a teacher. Multiple participants mentioned that although they did not originally know the facilitators of a PD experience, when the facilitators were willing to make changes based on the feedback they provided, it built a level of trust with them. For example, Ann said when the PD this fall was adapted to be asynchronous to allow teachers to view it on their own time, she decided she was going to make the time to view it and actually implemented strategies given in her classroom that she may not have implemented. She explained that, because the presenters heard their frustration and knew the model was not working, she felt like they trusted her as a professional. Teachers stated they were more willing to participate and share ideas, as well as provide feedback on how to improve the PD sessions when trust was built. Tara mentioned a PD experience that was over fifteen years prior, but still was very impactful on how she teaches math due to the presenter taking the time at each session to ask them what questions they had and what more they needed. She then said, "she didn't just ask, but she changed the next session based on what we said." Participants shared that time to build trust and rapport by getting to know each other within the PD session was important for them to be willing to change their practices within the classroom.

Conclusion

Participants in this case study were very candid with their responses around how PD experiences may or may not impact their beliefs about their teaching abilities, teacher efficacy, and their instructional practices. They revealed the need for PD experiences to be responsive to

their individual and collective needs while still providing an opportunity to allow them to grow as professionals. Participants explained that not all PD experiences are created equal and having extended opportunities to work with colleagues and experts in the field to improve their instructional practices are important but need to be organized thoughtfully and purposefully. Chapter five will provide more insight into how these themes that emerged can provide further implications, opportunities for future study, as well as recommendations for action.

CHAPTER FIVE

CONCLUSION

The purpose of this qualitative case study was to examine the experiences of rural elementary math teachers with professional development (PD) focused on mathematics. Understanding that elementary teachers in the United States do not usually have a strong math background (Reid & Reid, 2017) and rural educators often have to fill multiple roles within a school (Glover et al., 2016), this study explored how PD experiences impacted the teaching of mathematics in a rural setting from the teachers' perspectives. This descriptive case study examined how PD experiences impacted these teachers' beliefs in their abilities to teach mathematics, their teacher efficacy related to mathematics, and their perceptions of quality math instruction. Chapter 5 includes the interpretation of those findings, the implications of the findings, recommendations for action, and recommendations for further study.

Interpretation of Findings

This study was conducted in a rural district in Maine with eight teachers who teach in kindergarten through fifth grade. The teachers are housed in two separate buildings as one building is for kindergarten through grade three and the other is grades four through eight. The study originally was focused on a mathematics PD experience that was happening within both buildings, but as teachers were asked questions during the interviews, they revealed information from as far back as their student teaching experiences. As the teachers reflected on their experiences with PD throughout their teaching career, they explained both the positive and negative experiences. Within the semi-structured interviews, they revealed information about how PD had impacted their personal beliefs about their teaching abilities, their teacher efficacy, and their perceptions of how math should be taught in the elementary grades. Their openness to

share their personal stories and provide a rich source of information around PD, sometimes over twenty years prior, showed that PD can have a lasting impact on educators in the field. The data analysis process provided themes that answered the three research questions.

Research Question 1: How do PD experiences impact rural elementary teachers' beliefs about their abilities to teach mathematics?

All of the participants were able to share stories of how PD experiences had impacted their beliefs about their abilities to teach mathematics. From the onset, seven of the eight participants divulged they were not confident teaching math based on the training they received in their college experience. Only one teacher had a degree in mathematics, while the other seven were elementary education generalists. Multiple participants described an aversion to mathematics as a student and a teacher. Elementary teachers with anxiety around teaching math have been shown to negatively impact the achievement of their students (Hadley & Doward, 2011). Even teachers with a strong mathematics background can sometimes struggle to model elementary math concepts (Holm & Kajander, 2019). Yet, all the participants responded that they were currently confident in their ability to teach mathematics to their students, even though many were not confident when first entering the profession. They attributed this confidence to two main themes: (1) conversations with and observations of their colleagues and (2) PD experiences, although not all are created equal.

Conversations with and observations of colleagues. All participants revealed having the ability to discuss with their colleagues what they were teaching and how they were teaching helped them to gain confidence in their own beliefs as a mathematics teacher. They stated when there was time for discussion with their fellow teachers built into a PD experience, they learned even more. Participants explained that often during the school day there is not time to ask each

other questions, so PD time to have those discussions around successes and challenges made an impact on their teaching. This is congruent with one of the key components of quality PD, collaboration, outlined in the United States Department of Education in its non-regulatory guidance for Title II Part A (2016). Kyoung-oh et al. (2018) found "content-focused, collaborative and active learning can produce change in teachers" (p. 968). Participants also explained having the ability to observe other teachers while they were teaching math provided them with new tools and strategies to use in their own instruction. The information gained from watching a veteran teacher who may utilize more scaffolding in instruction, a game, or provide feedback in a different way was important for all participants. The opportunity to have multiple options for teaching students a similar concept improved their own ability to teach math, as they felt they had less students who were unsuccessful.

PD experiences are not all equal. Educators have the opportunity to participate in many PD experiences in their careers (Guskey, 2021, p. 54). The participants in this study each described multiple experiences they remembered from their educational careers. Although many of them were positive and memorable experiences for teachers, there were some that actually negatively impacted the teacher's beliefs about their abilities to teach math. The PD experiences that had a negative impact on teachers' beliefs in their abilities were ones that caused the teacher to doubt their ability in the classroom. Participants explained if the content was too philosophical or impractical for classroom implementation, then they would walk away feeling it was a waste of time or worse, inadequate in their own teaching. Most of the PD experiences described by the participants had positive impacts on teachers' beliefs in their own abilities. They expressed that when they were allowed to grapple with content in new ways, even though it was hard work and they left exhausted, they knew they would be able to use the information with

their students. When participants were provided with new tools and strategies for instruction that they themselves had the opportunity to experience as a student, they felt more confident in their ability to use it in a classroom.

Research Question 2: How do PD experiences impact rural elementary teachers' efficacy in regards to mathematics instruction?

Teacher efficacy is the belief a teacher has that they can make an impact on the students in the classroom (Katz & Stupel, 2015). Participants shared that PD experiences created excitement and confidence in their own abilities, thus creating a higher level of teacher efficacy. When participants were asked about their ability to improve students' mathematics achievement, they all said they felt they were able to improve achievement in their classroom. They even provided examples from student work or from anecdotal evidence that students were achieving in the classroom using tools and strategies learned from specific PD experiences. Only one teacher referenced a norm measure of a tool for measuring achievement, as teachers often trust their evidence from the classroom versus normed tests as a tool for judging success of students' achievement (Guskey, 2021). Most participants explained they perceived a positive impact on achievement in relationship to student growth over time or student enthusiasm around learning math topics.

A common theme in relationship to teacher efficacy was the belief of participants that all students may not be at exactly the place teachers want them to be at the end of the year. The participants in the study did not seem worried by the notion that students were not all achieving at the same rate, but rather looked to students' confidence in mathematics, ability to apply skills and knowledge, and growth over time as the measure of success over time. Nurlu (2015) found that teachers with a higher teaching efficacy were open to new ideas, emphasized student

relationships, and took more responsibility for student success. The participants in the study showed evidence from their descriptions of these characteristics. They wanted to describe how they implemented a new strategy for a student who was struggling or how they would adjust instruction based on the interests of their students, versus providing only specific achievement data justifying achievement.

Research Question 3: How do rural elementary teachers describe how PD impacts their perception of mathematics instruction?

Participants revealed PD experiences that were provided by people who were experts in mathematics had varying levels of success in changing their perception of mathematics instruction. Yet, when those experts provided tools or strategies that participants could immediately use in their classrooms with success as evidenced by either student achievement or engagement, then teachers would be willing to take risks with other strategies learned in the PD that were not so easily implemented. Teachers with a growth mindset are more apt to try new strategies in their classrooms and encourage their children to try those strategies (Dweck, 2007). The majority of participants in the study had growth mindset tendencies.

A second theme related to this question was the PD experience had to be provided by someone who was trusted to have experience or at least a vested interest in their success as a teacher. Participants explained that when a facilitator adjusted the PD session based on their feedback, allowed them to share stories of success and/or challenges, and responded to their needs in the moment, they felt the facilitator was trustworthy. Participants shared having a mutual respect and trust, allowed them to gain more skills and knowledge that directly impacted their math instruction. When they felt the facilitator trusted them as a professional and valued their ideas, they would in turn reciprocate with the facilitator.

Implications

The findings of this study contributed to the body of literature around PD experiences in rural education settings by highlighting the key components revealed by participants in this qualitative descriptive case study. The themes revealed within the research questions provide four implications for those wanting to have an impact on rural elementary educators.

Implication #1: PD impacts Rural Teachers' Beliefs and Efficacy

Participants clearly revealed that PD impacts their beliefs about their abilities to teach mathematics and their teacher efficacy. They were able to share experiences from as recent as a few months to experiences that were over thirty years old. Participants' abilities to describe the details of lessons learned, emotions experienced, and student achievement related to each of those experiences demonstrated that PD leaves an impression on educators. This aligns with research by Liang et al. (2015) that found a positive association between teachers who participated in PD and student achievement. Although not all PD experiences are equal, they do have an impact. Gissy (2010) found PD experiences focused on an immediate classroom need were viewed more favorably than those that did not have a direct correlation to work being done in the classroom. The participants in this study re-affirmed that as they described when strategies which were easily implemented were provided, they were more likely to try other recommendations from the PD.

Implication #2: Collaborative Conversations and Observations Matter

PD experiences need to include opportunities for collaborative conversations and opportunities to observe others. Teachers shared that sustained professional development that improved collaboration and collegiality was an important influence on the successful implementation of new learning (Green & Kent, 2016; Moore, 2009; Smith, 2017; Wilson et al.,

2017). In addition, Kyoung-oh et al. (2018) found "improving teachers' collaborative participation in professional development raises expectations for student achievement and fosters a positive awareness of their success in educational activities" (p. 969). Providing teachers with collaborative opportunities to work through the content and persist through challenges, much in the same way their students will, has been shown to have positive results with changing teacher instructional practices (Clarke et al., 2014). All of these studies re-affirm what the teachers expressed in this case study of the need to talk and learn with each other.

Implication #3: Teachers have Experiences to Share and Learn From

This case study shows that educators have a wealth of experience and knowledge to share about what works and does not work in their classrooms and PD experiences. The eight participants of this study shared personal successes, failures, and current challenges in an effort to support future endeavors for other educators. They were willing to give of their own time to support a research effort focused on understanding their experiences. Policy makers, district leaders, building leaders, and others need to provide opportunities for educators who are closest to the students to provide feedback on the processes and procedures that impact them directly.

Implication #4: Trust is Essential

The participants in this study explained that trust amongst participants and with the providers of the PD was essential for implementation or change to happen within the classroom. Trust needs to be developed explicitly as part of a PD experience to encourage risk-taking by teachers. Knight (2021) states that professional developers need to provide quality opportunities for educators through affirmation and clear guidance. As trust is developed, teachers are more willing to implement a new tool or strategy as they believe they have a person or people who

believe in their abilities. DuFour and Fullan (2013) found that teachers have to believe a change is feasible and will produce actual results.

Recommendations for Action

It was clear from this case study that PD experiences make a difference for rural elementary math teachers who may not have been adequately prepared to teach math in their college preparation. Participants were able to describe experiences that were recent, as well as those that were many years prior and were able to explain how those experiences impacted their ability to teach mathematics, teacher efficacy, and beliefs about quality math instruction. Given that there are teacher shortages in mathematics (United States Department of Education, 2019) and rural districts can experience a greater need as they work to recruit teachers to teach in more remote areas (Lowe, 2018), this study provides three recommendations based on the information gleaned.

Recommendation #1: Provide PD Focused on Teachers' Needs

Administrators and teachers need to use quantitative and qualitative data to determine the PD needs of staff (McGee, Wang, & Drew, 2013). Teachers need to have a clear purpose in participating with a PD experience, so they understand why they are trying these new skills or strategies (Guskey, 2021). As participants in the study shared, when they knew they were learning strategies, content, or skills that had been successfully implemented in other classrooms, they were more willing to try them in their own. Teachers need to feel the PD experience is relevant to their current teaching situation. They need be able to easily apply the tools or strategies within their classroom. The participants in the study explained the ease of use and application of the content for immediate use within their classroom was a major component of whether or not their instructional practice changed.

Recommendation #2: Include All the Qualities of High-Quality PD in an Experience

PD needs to be sustained, intensive, collaborative, job-embedded, classroom-focused, and data-driven (United States Department of Education, 2016). Participants were clear that not all PD experiences were created equal. Those experiences that had positive lasting impact had all of the qualities listed above with a focus on collaboration with peers both within a grade-level and across grade levels sustained over at least one semester, ideally over multiple years. As school districts work to build up their current teaching staff, they have to be careful to provide opportunities for PD that will have positive lasting impacts over time. Kyoung, et al. (2018) found by having high-quality PD experiences, educators had higher job satisfaction. Rural schools can improve their current teaching staff abilities by providing opportunities that allow them to build connections with others (Barrett et al., 2015; Smith et al., 2013). When PD experiences are haphazard, then there is no cohesion amongst staff with common language or expectations.

Recommendation #3: Build a Culture of Trust

Participants in the study were very clear that trust was critical to the success of a PD experience. The teachers needed to feel they could share without judgement successes or challenges, as well as feel that the facilitator/provider of the PD had expertise in what they were presenting to staff. If either of these aspects were lacking, participants shared negative feelings about the experience and often did not implement what was learned. Those who are responsible for providing PD need to provide explicit and authentic opportunities for participants to build trust within the group. This may mean changing an agenda or session based on the immediate needs of the teachers present or adapting the delivery method based on feedback from

participants. PD experiences must be thoughtfully and intentionally planned to allow risk-taking and modeling.

Recommendations for Further Study

The participants in this study volunteered and many of them perceived they had a growth mindset prior to the PD experience. A recommendation would be to complete a similar study with the entire staff and then expand it to other districts. The themes and implications were congruent with the research around high-quality PD experiences but having a larger demographic of teachers could provide greater insight into how and why PD experiences impact instructional practice within elementary math classrooms.

This study examined individual teacher efficacy in mathematics. Future studies could examine how PD impacts collective efficacy. According to Donohoo (2017), collective efficacy has a greater impact on student achievement than home environment and parent involvement. Participants alluded to the need for collaborative conversations and problem solving which would imply collective efficacy was enhanced but follow-up interviews with teachers would be able to determine how PD experiences impact collective efficacy.

A study using quantitative measures for efficacy with teachers in specific experience bands would show if these same themes emerged with teachers who are newer to the profession, as all these participants had at least five years of experience. The information shared about feeling a lack of preparedness to teach math in the elementary school may be explored with those who have less than five years, as the lack of preparedness for teaching math was a theme that emerged in the demographic data which aligned to the literature review.

Finally, continuing to engage teachers in dialogue around how their own experiences have impacted or not impacted their teaching is something for further to study. As education is

constantly evolving and changing, teachers need to have an opportunity to express with the larger community of educational policymakers, leaders, and stakeholders on their personal experiences to continue to improve the profession.

Conclusion

In this descriptive case study, eight rural teachers willingly described how their math PD experiences impacted their own beliefs, efficacy, and instructional practices. The purpose of the study was to examine PD experiences from the voice of the educators who were involved, not based on the goals of the PD or student achievement data. The participants provided information addressing the three research questions as well as themes around the need for collaborative discussions, observations of other teachers, easily implemented tools and strategies, a culture of trust, and the ability to measure student success with multiple measures. These descriptions were consistent with the current literature around what constitutes quality PD experiences (Barrett et al., 2015; Guskey, 2021; Knight, 2021; Kyoung-oh et al., 2018; Smith et al., 2013, United States Department of Education, 2016). This study allowed the participants to expound on their experiences throughout all their years in education and was not isolated to one PD experience.

Rural schools have many challenges due to their remote locations and teacher shortages (Lowe, 2018). Using PD experiences to enhance skills and knowledge of the teaching staff provides a stronger educational experience for their students. Looking forward, it is important for policymakers and leaders to realize that not all PD experiences are equal and must be intentionally planned to focus on the outcomes desired (Guskey, 2021). PD experiences are most effective when they reflect the most current research on teacher efficacy, both individual and collective. Teachers need to be provided an opportunity to give feedback on the experiences to work on a continuous improvement model for both the educators, the school, and the district.

Opportunities that include teachers in continuous improvement models include the aspects discussed throughout this study. Futhermore, ongoing dialogue to allow teachers involved in specific PD experiences to provide feedback creates qualitative data upon which to base future PD decisions. As evidenced by this study, teachers are impacted by PD experiences for many years after they participate.

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Appendix A
Site Permission

University of New England Doctoral Program in Educational Leadership

This proposal serves as the request to conduct research in the RSU No. 67 School District per Administrative Regulation 6162.8

Name of Researcher

My name is Heather Rockwell and I am a graduate student at in the doctorate program in education at the University of New England.

I am conducting a research study designed to understand rural elementary education teachers and the impact of a mathematics professional development on their instruction and mathematical beliefs.

Method of Study

The method of study I will use is a qualitative case study. It includes conducting interviews with elementary teachers who volunteer to participate in the research, reviewing artifact data such as exit slips from the professional development and sanitized student work samples, and classroom observation data focused on the teacher only. There will be no student involvement in this research project.

Benefits to the school or district

There are no monetary benefits to the RSU No. 67 School District for participating in this research, although it is my hope that the findings of my study will provide insight that will help RSU No.67 and other school districts to improve the development and implementation of professional development linked to district goals.

Proposed Project Period

The proposed research period is from October 1, 2020 through March 30, 2021.

Participation

All participants will be asked to sign an informed consent to participate. All participants will be informed of the purpose of the research and the researcher will be responsible to obtain consent from each participant. Participants will be informed that their participation is completely voluntary. Participants can choose to answer only the questions with which they feel comfortable and can discontinue participation at any time.

Privacy will be protected in several ways. I will not share who participates in the study with any other employees of the district. All personal information will be sanitized from interviews by using pseudonyms and coding the data as needed. No real names or any

other identifiable information will appear in any published reports of the research. The research material, including recordings of interviews and transcriptions will be kept in a password protected, encrypted personal server, and only I will have access to the data. Any paper artifacts or notes will be kept in a locked safe that only the researcher has access to and destroyed after the completion of the study.

Certification

This letter is to certify that information obtained from research will not include names of interviewees, schools, districts, student names or personal information.

Appendix B

Email for Recruiting Teachers

Email for Recruiting Teachers

Hello. I am in the process of completing my Doctoral program with the University of New England and am conducting a research study. The study is focused on understanding rural elementary math teachers experience in a professional development endeavor. I am looking for eight or more teachers who would be willing to participate in the study. Participation will include participating in two interviews, approximately forty-five minutes to an hour in length and one classroom observation. Interviews will be conducted via Zoom at a convenient time for you. Prior to conducting the interviews, you will receive a consent form and have an opportunity to ask any further questions. Your participation is completely voluntary and confidential. No other staff will know your participating. I am committed to protecting your privacy and confidentiality. Thank you for considering participating in this project. Please email me directly if you are interested.

Appendix C

Participant Consent Form

Participant Consent Form

UNIVERSITY OF NEW ENGLAND
CONSENT FOR PARTCIPATION IN RESEARCH

Project Title: Rural Elementary Teachers and The Impact of Professional Development on Mathematics Instruction
Principal Investigator(s): Heather Rockwell
Introduction:

- Please read this form. You may also request that the form is read to you. The purpose of this form is to give you information about this research study, and if you choose to participate, document that choice.
- You are encouraged to ask any questions that you may have about this study, now, during or after the project is complete. You can take as much time as you need to decide whether or not you want to participate. Your participation is voluntary.

Why is this research study being done?
This research study is a completion of the dissertation program of the researcher. The goal is to understand the professional development experience from the elementary teachers' perspective.
Who will be in this study?
8 to 16 elementary teachers
What will I be asked to do?
You will participate in two interviews lasting approximately 45 minutes each. You will also be asked to share any sample notes or evidence you have related to how a professional development experience impacted your instruction. A classroom observation will be completed as well focused on your implementation of the professional development tools learned.

What are the possible risks of taking part in this study?
There are no risks of taking part in this study.

What are the possible benefits of taking part in this study?
You will have an opportunity to reflect on a professional development experience and share your thoughts with the researcher that may impact future experiences for teachers.

What will it cost me?
It will cost you nothing except the time for the two interviews.

How will my privacy be protected?
Privacy will be protected through a variety of measures. The researcher will not share who participated in the research study. The researcher will not use any identifiable information when transcribing and coding the interviews and artifacts. Pseudonyms will be used and all other identifiable information will be sanitized from the data. All materials, including interview

recordings and transcriptions, will be stored in a password protected, encrypted personal server only accessible by the researcher and destroyed after five years. Transcriptions of the interviews will be shared with participants for member checking via a secure email address.

How will my data be kept confidential?

The data will not include any personal identifiable information. No specific information will be shared that includes participants' names or that may otherwise identify the participants throughout the process.

What are my rights as a research participant?

- Your participation is voluntary. Your decision to participate will have no impact on your current or future relations with the University.
- Your decision to participate will not affect your relationship with Heather Rockwell.
- You may skip or refuse to answer any question for any reason.
- If you choose not to participate there is no penalty to you and you will not lose any benefits that you are otherwise entitled to receive.
- You are free to withdraw from this research study at any time, for any reason.
    - If you choose to withdraw from the research there will be no penalty to you and you will not lose any benefits that you are otherwise entitled to receive.
- You will be informed of any significant findings developed during the course of the research that may affect your willingness to participate in the research.
- If you sustain an injury while participating in this study, your participation may be ended.

What other options do I have?

- You may choose not to participate.

Whom may I contact with questions?

- The researcher conducting this study is Heather Rockwell.
    - For more information regarding this study, please contact Heather Rockwell.
- If you choose to participate in this research study and believe you may have suffered a research related injury, please contact Dr. Cynthia Kennedy at ckennedy5@une.edu
- If you have any questions or concerns about your rights as a research subject, you may call Mary Bachman DeSilva, Sc.D., Chair of the UNE Institutional Review Board at (207) 221-4567 or irb@une.edu.

Will I receive a copy of this consent form?

- You will be given a copy of this consent form.

PARTICIPANT'S STATEMENT

I understand the above description of this research and the risks and benefits associated with my participation as a research subject. I agree to take part in the research and do so voluntarily.

_____ _____

Participant's signature or
Legally authorized representative

Date

Printed name

RESEARCHER'S STATEMENT

The participant named above had sufficient time to consider the information, had an opportunity to ask questions, and voluntarily agreed to be in this study.

Researcher's signature

Date

Printed name

Appendix D

Semi-structured Interview Protocol

Semi-structured Interview Protocol

Interview #1

Date:

Time:

Introduction: Thank you for taking the time to participate in this interview with me today. As a doctoral student at the University of New England, the focus of my research is to understand a mathematics professional development experience from the elementary teachers involved in it. I appreciate your willingness to be part of this study. With your permission, I will record this interview. It should last between 45-60 minutes. My goal is to understand your experience during the professional development as well as how it impacted your classroom instruction. Your answers are confidential, so please share as much as you feel comfortable sharing.

Do you have any questions you would like to ask?

With your permission, I will begin the recording.

I am going to start with some demographic questions and then move on to the questions around the research study.

Demographic questions:

1. How long have you taught in this district?
2. How long have you been teaching math in the elementary setting?
3. What grade levels have you taught, including your current assignment?
4. I'm going to read four statements from Dweck (2006) and would like to know if you mostly agree or mostly disagree with each one.
    a. Your intelligence is something very basic about you that you can't change very much.
    b. You can learn new things, but you really can't change how intelligent you are.
    c. No matter how much intelligence you have, you can always change it quite a bit.
    d. You can always substantially change how intelligent you are. (p. 12)

SOURCE: Dweck, C.S. (2006). *Mindset*. New York, NY: Random House.

Semi-structured interview questions:

5. Please discuss how your experiences and education prepared you to teach math in the elementary setting?

6. How do you believe students best learn mathematics?

7. How does this align with how you teach mathematics?

8. How did the PD provided impact your beliefs about how students learn mathematics?

9. How did the PD provided impact your feelings about your ability to teach mathematics to students?

10. How well do you think you motivate students to do well in mathematics?

11. How did the PD impact this ability?

12. Do you think all students can do well in mathematics? How did this PD experience impact that answer?

Closing:

Thank you so much for your time and your responses. I will transcribe this interview and provide you with a copy of the transcription. You may provide comments on what is transcribed to make sure it accurately captures your thoughts and ideas. Remember the interview and transcription are completely confidential and will not be shared with anyone else. Thank you again for participating and sharing your ideas and experience. I look forward to our classroom observation and second interview.

End of Semi-structured Interview #1

Semi-structured Interview #2:

Thank you again for taking the time to meet with me for this interview. A reminder that I will be recording the interview and you may choose to answer questions as in-depth or as little as you would like. Your participation is completely voluntary and your answers will be kept confidential.

Interview questions:

1. How did the PD experience impact your teaching of mathematics?
    a. Follow-up: Why did you implement specific new strategies in your instruction?
2. How did implementing these new strategies or ideas provide evidence of impacting student achievement in mathematics?

3. How did the PD impact your day-to-day mathematics instruction?
    a. Follow-up: Why did you make those adjustments?
4. How do you think this PD experience impact your view of mathematics instruction?

Closing:

Thank you so much for your time and your responses. I will transcribe this interview and provide you with a copy of the transcription. You may provide comments on what is transcribed to make sure it accurately captures your thoughts and ideas. Remember the interview and transcription are completely confidential and will not be shared with anyone else. Thank you again for participating and sharing your ideas and experience.