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The Relationship Between Professional Development, Instruction, and Student Achievement in Elementary Mathematics

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Abstract

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Project Study Submitted in Partial Fulfillment

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Abstract

Many school districts acknowledge professional development (PD) as an approach that can change teaching practices and improve student achievement. Because elementary teachers often struggle to provide instruction for mathematical proficiency, the purpose of this quantitative study was to examine the strength of the relationships among teacher participation in math PD courses, Texas Teacher Evaluation and Support System (T-TESS) implementation scores, and student achievement. The theoretical framework for the study is based on Guskey's model of teacher change. The research questions pertained to the strength of the relationship between the following pairs of variables: (a) teacher participation in math PD and student achievement; (b) teacher participation in math PD and T-TESS implementation scores, and (c) T-TESS implementation scores a and student achievement. Pearson's product moment correlations were used to quantify the strength of the association between each pair of variables. The study included a sample of 34 third-grade teachers who had math PD participation hours, student scores from the state math assessment, and T-TESS implementation scores from the teacher appraisal instrument. The results of the study revealed no statistically significant relationships between the variables. Therefore, further research is required to investigate why teacher participation in PD demonstrated nonsignificant relationships among the variables. The policy recommendation developed following the completion of the study is intended to help school districts design effective PD programs. This study can effect positive social change with the implementation of effective PD methods to improve student achievement in mathematics.

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Section 1: The Problem

The Local Problem

Schools in the United States face increasing challenges with poor student performance in elementary mathematics (Ottmar, Rimm-Kaufman, & Berry, 2015). This has become a widespread issue, as a large proportion of American students learning mathematics do not acquire the foundational skills required to learn advanced mathematics (Andrews & Sayers, 2015). Further, difficulties in mathematics worsen over time. The problems American students have acquiring mathematical concepts in elementary school can be traced to several key factors, particularly a deficiency in whole number competence (Jordan et al., 2013).

Teaching math content in an elementary classroom is not simply a matter of learning basic measurement and arithmetic skills (Cathery, 2017). It entails understanding a concept in detail, including what the concept means, and the algorithms necessary to address it. But teachers' views about learning mathematics influence their teaching methods (Willingham, 2017). Additionally, many teachers do not understand the everyday application of many of the math concepts they teach, which limits their ability to make math relevant to their students (Willingham, 2017). Because many teachers use instructional routines based on their own understanding of math concepts and their past experiences in learning mathematics, mathematics instruction in elementary classrooms is often limited to rote memorization techniques that do not provide opportunities to pose or solve problems that expand students' mathematical thinking (Wickstorm, 2017).

For the past two decades, there has been growing concern that U.S. educational systems are inadequately preparing students to enter the 21st century workforce. Because individuals in the workforce are not required to think critically, math instruction must do more than teach students the way to perform rote procedures (Boes & Ruff, 2014). Most Fortune 500 companies today value skills in problem solving and creative thinking, so teachers must support students' development of conceptual understanding and offer multiple curricula and media experiences that enhance their ability to think critically (Robinson, Wendland, & Williams, 2015).

Definition of the Problem

Many teachers do not view the concepts they teach as fixed networks of interconnected skills when they teach elementary mathematics (Hart, Oesterle, & Swars, 2013). They may have limited content knowledge due to their prior mathematics learning, and most elementary teachers' understanding of math instruction is based to a greater extent on procedures and rules than on concepts (Cabana et al., 2017). Additionally, teachers are given a long list of content to teach and little time to teach it in depth. The combination of these factors has resulted in poor achievement on the part of elementary students in U.S. schools.

Student performance in elementary mathematics at a Texas School District (TXSD) reflects the widespread difficulty facing students who lack fundamental math skills. In Texas, third through fifth grade students are assessed annually with the State of Texas Assessments of Academic Readiness (STAAR). The performance category labels for the STAAR assessment for the 2015 administration were: Level III: Advanced

Academic Performance; Level II: Satisfactory Academic Performance, and Level I: Unsatisfactory. Among the 57% of the TXSD's third grade population tested who met the minimum standard of proficiency in elementary mathematics during the 2015 test administration year, 60% scored satisfactory in the subtests of Patterns, Relationships and Algebraic Reasoning. The Algebraic Reasoning subtest of the state assessment contains skills that are critical for students to become proficient numerically. This is below the state average of 65% for Patterns, Relationships and Algebraic Reasoning. TXSD has responded to this lack of achievement by monitoring elementary teachers' classroom instruction of foundational mathematical skills through a new professional learning initiative. The goal of this study was to investigate the relationship between TXSD elementary students' scores on the STAAR and the number of teachers who attended TXSD's (dosage) professional learning initiatives for elementary teachers who teach math content.

Rationale

Evidence of the Problem at the Local Level

Math achievement of U.S. fourth graders taking the Trends in International Mathematics and Science Study tests has been lower than that of their counterparts in at least eight other countries (Wijaya, 2017). When students begin experiencing math difficulties in elementary school, they often continue into high school (Riccomini & Cozad, 2016). Students neither think about numbers and their relationships in problem-solving situations, nor do they grasp the application of number relationships in the real world. But a student's ability to apply number relationships and patterns to real world experiences marks the beginning of seeing the world mathematically (Cortes, 2013). When students begin to consider the world mathematically, they are able to think about and use numbers and number relationships in a variety of ways (Copur-Gencturk, 2013).

To address students' lack of math achievement, it is important to address how teachers are instructing math. Guskey's (2017) model of teacher change details ways to view changes in teachers and implications for their professional development (PD). The model can help improve student learning by fostering teacher learning, which made it appropriate as the theoretical framework for TXSD's PD program and this study. The model depicts a series of events beginning with PD experiences that foster adjustments in teachers' pedagogical approaches. Guskey's model is used to examine the conditions under which change takes place, consider the way specific aspects of that change might be facilitated and sustained, and discuss the implications for the implementation of PD.

The Texas district outlined a tiered system of support for all schools based on Guskey's model to foster teacher learning through TXSD's Five Year Strategic Plan initiative. TXSD defined PD in its' Five-Year Strategic Plan through its Theory of Action Initiative. The plan delineates what type of tiered support each school requires. It also aligns the curriculum consistent with corresponding progress measures supported by differentiated PD. The expected outcomes of the tiered system of support the district's Theory of Action Initiative defined included expectations to improve student achievement by strengthening initial instruction district-wide, improving collaboration and planning among school instructional personnel, strengthening the teacher leadership structures to build teaching capacity, and ensuring collaboration among campus principals, their immediate supervisors, assistant superintendents, and personnel in the Curriculum and Instruction and Workforce Development Departments.

In response to low student mathematical performance trends identified in the district's accountability reports, TXSD's Administrative Leadership Team (board, superintendent, curriculum and instruction directors, and principals) hopes to improve teachers' instruction and students' mathematics knowledge by providing PD for all elementary mathematics teachers using Guskey's model as the foundation for the Texas Teacher Evaluation and Support System (T-TESS). TXSD implemented T-TESS as its teacher appraisal system in the 2015-2016 school year. T-TESS is a process to develop teacher habits through continuous improvement, which is best done when appraisers and teachers focus on evidence-based feedback in ongoing dialogue and collaboration to make PD decisions that best suit the school. Thus, TXSD uses the T-TESS to promote teacher growth through frequent and sustained feedback loops as well as define and demonstrate the evaluation domains, dimensions, and descriptors necessary to support teachers as they implement strategies that address all students' learning needs.

The T-TESS includes three components: a goal-setting conference and PD plan, the evaluation cycle, and student growth. The rubric includes four domains and 16 dimensions, which include specific descriptors of practices and five performance levels. For instance, T-TESS Domain 4: Professional Practices and Responsibility standard 4:3, "Professional Development," provides teachers in Texas the opportunity to design their own PD plan that fosters teacher learning and growth and is consistent with Guskey's model (2017). TXSD implements the T-TESS rubric as part of the district's formal evaluation cycle for instructional staff, which includes observations and walkthroughs using the rubric's four domains (planning, instruction, learning environment, and professional practices and responsibilities) with the 16-dimension descriptors that establish a common language for evaluation. In TXSD, the evaluator completes at least one formal, 45-minute observation and three formal, 10-minute walkthroughs annually. Evaluators then use the observation and walkthrough data to provide the teacher with written feedback within 5-10 days that includes a performance level score based on the data. The T-TESS five performance levels are *distinguished* (5), *accomplished* (4), *proficient* (3), *developing* (2), and *improvement needed* (1).

In response to the new teacher evaluation system and consistent with Guskey's (2017) model and the T-TESS (2014), the TXSD Human Resource Department developed a new PD department called Workforce Development in 2015. Workforce Development consists of 30 teacher development specialists, one elementary director, one secondary director, one new teacher induction director, one special education, and one executive director who lead the entire department. Workforce Development provides professional learning experiences in a variety of ways across all of TXSD's 36 school campuses. The new professional learning initiative the district's Workforce Development Department defined monitors and fosters elementary teachers' instruction in foundational mathematical skills. The department provides professional learning opportunities that are consistent with the TXSD curriculum and the three focus areas: curriculum consistency and effective implementation, literacy across all content areas, and differentiated instruction and effective monitoring of all student groups.

Based on the district's Professional Learning Plan, all teachers, regardless of years of experience, are required to complete 50 district-approved professional development (PD) hours from April 1-March 31 each year in workshops or courses that may be taken during or after the teacher's contract employment hours. The school principal must approve each teacher's professional learning experience in pre-conference T-TESS goal-setting meetings. Workshops or courses must relate to the teacher's teaching position and focus on helping him or her improve performance that leads to increased student achievement and school improvement.

Examining and using data to inform PD design is another new process the district has implemented in response to student's poor mathematics performance. TXSD's Accountability Department purchased a new data management system to analyze state, district, and campus student performance data by student and standard. District leaders want to determine whether the new PD program is making a difference for teachers and whether the PD practices increase student learning outcomes.

TXSD's professional Workforce Development learning initiative is based on the belief that PD experiences lead to effective instruction for every student every day. The implementation of professional learning at the school level requires teachers' long-term and regular involvement (Killion, 2016). It is important for both district and campus leadership to plan PD curricula with the help of school principals and school leadership personnel, including instructional coaches, teacher mentors, master teachers, or other teacher leaders. The purpose of this study was to determine the extent to which attendance at district-sponsored PD influences student achievement. In this study, I identified the relationship between the number of math PD sessions teachers attend (dosage) and student scores on the STAAR Assessment for elementary math.

Definition of Terms

Early numeracy: This refers to math content taught during the first years of formal schooling. Instruction includes conceptual understanding of numbers, computational fluency, and problem solving. Early numeracy also refers to a student's ability to understand place value to support algorithmic computations involving all four operations and the reasoning skills that underpin mathematical thinking (Journal of Education and Training Studies, 2013).

STAAR: The STAAR program for elementary students is an annual assessment of reading, writing, mathematics, social studies, and science skills that provides data that indicating whether students are college and career ready (Texas Education Agency, 2015). This newer assessment model is based on the Texas state standards referred to as the Texas Essential Knowledge and Skills.

Theory of action: A consistent curriculum with corresponding progress measures supported by differentiated PD and implemented with fidelity results in increased student achievement (TXSD [School Leadership/Curriculum, Instruction & Assessment/Workforce Development], 2015).

Significance of the Study

In 2010, The National Council of Teaching Mathematics changed math educational practices (the way math should be taught), which included a revision of the national math standards. The revised curriculum standards for math reflected an increase in process approaches to promote a deeper understanding of math content standards. This shift in the new way math should be taught requires teachers to teach math concepts through the lens of application and problem-solving; however, teachers often experience difficulty adopting this required pedagogical shift in math instruction (Asturias, Cheuk, Daro, Hampton & Stage, 2013).

Children's early number sense and acquisition of math content knowledge are essential for their later success in life (West, 2016). The acquisition of early number skills is a predictor of subsequent success, as it provides a foundation for understanding advanced mathematical concepts. For instance, the level of acquisition of general math concepts measured in kindergarten is predictive of math performance measured in approximately the third grade (Claessens & Engel, 2013). However, no single teacher knows everything required to teach mathematics and help students learn beyond what is necessary to achieve a passing grade. Thus, strategic planning processes for PD must change to meet the curricular, instructional, and assessment changes necessary for 21st-century learners (Anttila, 2016). If schools implement new content standards yet continue to resort to familiar approaches to PD such as single, short-term informational sessions, they will fall far short of the standards-driven PD teachers need (Reddy, 2015). But effective PD can improve teachers' instructional practices by extending their math pedagogical content knowledge (Pointe & Taylan, 2015).

Investigating the direction and strength of the relationship between elementary students' math proficiency in TXSD and the number of PD sessions their teachers attend will foster changes in educators' instructional practices and student learning experiences.

The theoretical framework informed the research questions and works to foster growth and teacher development with the goal to improve student learning. However, all stakeholders must collaborate to ensure that student achievement goals are met, and progress is communicated frequently (Rivera, 2013). Studying this problem will support effective use of district data as a hallmark to improve schools through a district PD model that focuses on changes in teacher attitudes and behavior to improve student academic outcomes. Furthermore, it is consistent with the study's research questions that address the direction and strength of the relation between the number of math content and process PD courses attended and the implementation scores from observations of strategies learned in PD and student achievement.

Research Questions and Hypotheses

It is important to use research to improve student performance (Education Trust, 2016). TXSD leaders examine student achievement data to inform the PD they offer and maintain quantitative data about the number of courses offered and number of attendees at each PD session or opportunity. This quantitative study was conducted to document the direction and strength of the relationships between the number of PD sessions attended, T-TESS implementation scores, and student achievement. The number of math content and process PD sessions attended was measured through session attendance reports to calculate each participant's total number of sessions. Teachers' T-TESS scores from district observations served as the proxy for implementation. The following research questions were designed to help address the purpose of this study:

Research Question 1: What is the direction and strength of the relationship between the number of math content PD courses attended and student achievement scores measured by STAAR?

$H_0$1: The number of math content PD sessions teachers attend is unrelated to student achievement measured by the STAAR.

H_a1: The number of math content PD sessions teachers attend is related positively to student achievement measured by the STAAR.

Research Question 2: What is the direction and strength of the relationship between the number of math process PD courses attended and student achievement scores measured by STAAR?

$H_0$2: The number of math process PD sessions teachers attend is unrelated to student achievement measured by the STAAR.

H_a2: The number of math process PD sessions teachers attend is related positively to student achievement measured by the STAAR.

Research Question 3: What is the direction and strength of the relationship between the number of math content PD courses attended and T-TESS scores?

$H_0$3: The number of math content PD sessions teachers attend is unrelated to effective implementation of the strategies as measured by implementation scores on T-TESS.

H_a3: The number of math content PD sessions teachers attend is related positively to effective implementation of the strategies as measured by implementation scores on T-TESS.

Research Question 4: What is the direction and strength of the relationship between the number of math process PD courses attended and T-TESS scores?

$H_0$4: The number of math process PD sessions teachers attend is unrelated to effective implementation of the strategies as measured by implementation scores on T-TESS.

H_a4: The number of math process PD sessions teachers attend is related positively to effective implementation of the strategies as measured by implementation scores on T-TESS.

Research Question 5: What is the direction and strength of the relationship between T-TESS scores and student achievement scores measured by STAAR?

$H_0$5: Effective implementation of strategies learned in PD measured by implementation scores on T-TESS is unrelated to student achievement.

H_a5: Effective implementation of strategies learned in PD measured by implementation scores on T-TESS is related positively to student achievement.

Review of the Literature

This literature review addresses two main themes: student mathematical achievement is below expected standards, and strategies are required to improve teachers' ability to convey knowledge of mathematics content acquired during PD opportunities and increase student achievement. Student achievement of elementary students learning math content is a major concern in U.S. schools (Jawic et al., 2016). Teachers' inability and/or unwillingness to provide students with mathematical experiences personally meaningful in their lives is a major factor that contributes to poor student performance in elementary classrooms.

Theoretical Framework

The PD framework detailed in Guskey's (2017) model of teacher change supports learning through constructivism. Two different aspects of constructivism are relevant to this study: cognitive and social. Piaget (1972) argued that individuals construct their ideas through a personal process using cognitive constructivism. He asserted that learning is always an active process during which learners develop knowledge structures by reflecting, analyzing, questioning, and solving problems. In a constructivist framework, the goal of knowledge acquisition is for learners to play an active role in assimilating new information and incorporating it into their existing framework or structure (Pelech, 2016).

Further, Vygotsky proposed that ideas and cognitive structures are constructed through interactions with other people (Karakus, 2017). Building a learning environment in which interactions are prominent helps develop effective learning experiences, as learners acquire knowledge more effectively when others support them. Thus, social interactions and cultural experiences affect the learner and the way in which learning occurs.

Cognitive and social constructivism also values inquiry learning, an approach that presents a problem embedded in a real-life experience and allows teachers to support the learner's process in solving problems (Lain, 2016). Both cognitive and social constructivist theories argue that facilitating information is necessary, as learners create their own ideas and understanding of what is being taught. Cognitive constructivism celebrates the individual, and the process used to acquire knowledge, whereas social constructivism supports engaging teachers and learners in activities that create relationships that affect what is learned directly. In TXSD's 2015 PD plan, PD experiences support teachers as they co-construct instructional models in which teachers and students engage in discourse about math content. The constructivism PD framework of Guskey's (2017) model defines the goal for PD in TXSD in which teachers play an active role in assimilating new knowledge through interactions with others during PD opportunities.

Effective Professional Development

Elementary teachers often have difficulty providing instruction essential for mathematical proficiency (Johnson et al., 2017; Mantera & Morris, 2017; Meixia, 2013). Indicators of math proficiency in elementary students include comprehension of math content; skills in performing procedures; ability to represent and solve math problems to explain, reflect, and justify thinking about mathematics; and the belief that mathematics is useful in the world (Mantera & Morris, 2017). But math instruction in the elementary classroom often results in more procedural tasks than teaching students to perform math processes fluently (Johnson et al., 2017). When math instruction is not based on and informed by conceptual knowledge, which can be connected to teachers' limited understanding of these concepts, students do not achieve the understanding necessary to progress. Without conceptual knowledge, students are unable to understand the relation between abstract symbols and the representations of essential math concepts (Johnson et al., 2016).

To address these issues with math instruction, PD is a comprehensive and sustained approach to improving educators' effectiveness in enhancing student performance (Dobbs et al., 2016). Students in schools with a PD program have demonstrated math proficiency on a state standardized test compared to those in the school without a PD program (Gersten et al., 2014). The first task in preparing teachers to teach mathematics is to identify student achievement goals consistent with their stages of cognitive development. During children's early experiences in school, they construct new knowledge to develop early number concepts and number sense during the sensory motor and preoperational stages of development (Matera et al., 2018). Students begin to explore their learning environment through their senses and physical endeavors. During the preoperational stage of development (ages 2-7), children learn to count and develop number relationships. Thus, as teachers work collaboratively as professional learners, they must identify their students' level of cognitive development with respect to the acquisition of early math skills and design a goal for each student based on his or her stage of development. However, teachers often miss this conversation during collaborative PD, which leads to ineffective instruction, especially during the early years of school (Levenson, 2013).

Researchers also have argued that too few teachers experience quality PD opportunities that use teamwork enabling them to become more effective educators (Blank, 2013; Falk, 2012; Gersten et al., 2014; Killion, 2016; Severson, 2016; Sevis et al., 2017). Effective instruction takes place when both teachers and school leaders participate in data-driven PD experiences in which they use data to determine student goals and design lessons with instructional approaches based on evidence, after which teachers are coached to improve their instructional abilities (Killion, 2016). In a study on team building to promote improved instruction and student performance, when teachers created a collaborative framework of team building, teamwork, and team lesson study, students' performance on state tests improved after 4 years (Severson, 2016). Additionally, online PD programs have been shown to be an effective approach to enhance elementary teachers' pedagogical content knowledge and instructional approaches (Sevis et al., 2017).

Effective PD delves deeper into the most important concepts and fosters collective responsibility for improved student performance (Abu-Tineh & Sadiq 2018). One example of a PD task that becomes a part of the improvement cycle for student achievement occurs when teachers are involved in an in-depth discussion of various forms of data. For example, McGinnis et al. (2016) investigated the relationship between elementary science teachers' content practices in formative assessments and the teachers' pedagogical knowledge of science content. The findings suggested that formative assessments enhance student learning by informing instructional practices that strengthen pedagogical content knowledge. For example, when educators examine student data as a professional learning community (PLC), student achievement increases for all student groups (Gersten et al., 2014).

Numerous researchers have also identified key attributes of quality PD (Arbour et al., 2016; Collins & Liang, 2015; Desimone & Pak 2017; Gaikhorst et al., 2015; Mayotte et al., 2013). For instance, it may be important to include common PD characteristics that lead to student achievement such as standards-based PD, which requires teachers to have deep subject knowledge and the pedagogy most effective to teach that subject (Blank, 2013). Additionally, effective PD is an opportunity to strengthen school personnel’s capacity when it is presented as a systematic, long-term experience (Arbour et al., 2016; Mayotte et al., 2013). Educators also appreciate being part of a team of professionals who are able to spend time and work with other educators as a way to achieve ongoing PD, and instructional coaching methods can help engage teachers in school improvement efforts that accelerate student learning (Desimone & Pak, 2017). Beneficial PD activities can include collaboration, individual inquiry, experimental learning, school based in-service activities, and graduate courses (Gaikhorst et al., 2015).

Early Math Skills

Traditional evaluation systems’ inherent inability to identify effective instructional practice limits schools’ ability to make strategic decisions about personnel, plan effective PD, or identify effective practices that lead directly to increased student achievement (Gunter, Lacey & Reeves, 2017). But evaluation systems such as the T-TESS Domain 4:3 help develop teachers because they are consistent with Guskey’s (2017) model in which PD is targeted to the needs associated with developing individual teacher’s growth plans. The T-TESS rubric helps teachers reflect on their instructional practices. Because of the rubric’s structure, the discussions between teachers and evaluators focus on the interactions between teachers and students. The conversations during pre- and post-conferencing may result in changes in teacher’s instructional strategies, routines, and practices. To support teachers in their PD during the school year, school principals use the T-TESS dimension descriptors scores to identify areas they will assess continually during the year, so they can make any adjustments in their instruction necessary. For example, teaching early math skills in elementary school is one of the critical content strategies in developing number sense (Manfra, 2014). According to Guskey's model, PD should provide personnel with opportunities to change classroom pedagogical practices by providing job-embedded PD (JEPD) experiences related directly to enhancing instruction in concepts such as early math skills, and teachers should use those experiences to practice and deepen their knowledge of new content in teaching mathematics.

Developing early math skills through a variety of number sense learning experiences is a prerequisite for success in mathematics (Dyson, Glutting, Hassinger-Das, Irwin & Jordan, 2014). Many researchers have argued that the development of early numerical knowledge is the missing component in learning early counting procedures, arithmetic, and number relationships. Students with weak number sense experience difficulties with mathematics that worsen over time (Classens & Engel, 2013). These authors agreed that elementary students' early number sense skills are essential for their later success in school. Mathematics education, particularly for children approximately three to six years of age, is important to promote a broad array of math concepts. Dodge, Godwin and Rabiner (2016) also argued that math skills at the age at which children enter school predict both math and reading skills in second and third grade. Instruction that involves math conversations leads to significant gains in math performance. Students who are involved in math instruction that develops, discusses, and uses efficient, accurate methods that can be generalized to solve math problems develop increased number sense. Thus, performance and progress in early number concepts and number sense during the students’ first year in formal school facilitates early math achievement (Matera & Morris, 2017).

Effective Math Instruction

Coherent math instruction assigns relevance to new learning, thereby increasing the opportunities that the learning will be retained (Johnson et al., 2016). Guskey’s (2017) model and T-TESS support specific strategies and teacher behaviors related to student achievement. For example, the T-TESS rubric differentiates among teaching practices and embeds feedback about effective math instruction. With the rubric, teachers have the opportunity to reflect as they plan and deliver math instruction. Consistent with the development of teachers’ instructional practices through PD, student achievement is related to specific strategies for effective math instruction.

Teachers’ perceptions about mathematics and learning are a frequent subject of research (Anderson, 2015; Battey, 2013, Ganley, Laski, Reeves, & Mitchell, 2013, Hopkins and Russo, 2017). Hopkins and Russo (2017) discovered that elementary teachers struggle to find applications for many of the math concepts they teach, which affects their ability to adopt instructional approaches that include communication, representation, problem solving, and reasoning connection adversely, and limits students’ ability to make mathematical concepts relevant. Anderson (2015) suggested that elementary teachers prepare students to perform mathematics in the classroom that is not used in the same way that it is outside the classroom, as many find it difficult to understand the meaning behind the mathematics they teach because they lack experience with the math concepts taught in elementary grades (Laski et al., 2013). Elementary teachers' low level of experience with mathematics content has adverse effects on instruction because they do not understand associations in depth (Battey, 2013).

Useful mathematical knowledge extends beyond knowing "how," math is taught with drills and procedures, to knowing "why" through relevant, real-life applications of math concepts (Gencturk & Lubienski, 2013). In response to teachers' lack of experience with mathematics content, Guskey's model (2017), encourages opportunities for teachers to receive PD designed specifically to strengthen their mathematical content knowledge. PD opportunities include weekly instructional coaching support, lesson planning guidance, and modeling of lesson delivery. Each PD course to which teachers commit provides new learning experiences that relate to student achievement (Linder, 2012).

Elementary teachers and state education agencies continue to investigate ways to improve students' learning outcomes in mathematics. Prusak et al. (2013) argued that eliciting and facilitating student learning in mathematics entails the expectation that teachers will support students' development of mathematics concepts by providing a variety of media and stimuli in the curriculum to do so. However, as previously discussed, instruction and learning of math content in U.S. elementary schools has been restricted to rote memorization of skills in isolation and does not encourage critical thinking about mathematics concepts (Johnson, Lambert, McGee, Polly, Pugalee & Wang, 2013). Many elementary teachers have low levels of math content knowledge and often are afraid to explore it more deeply. Prusack et al. (2013) indicated that elementary teachers say that much of the mathematical understanding they possess focuses on procedures and rules rather than concepts.

Effective mathematics instruction occurs when the learning environment encourages students to work together to solve problems. According to Killion (2016), excellent teaching every day in all classrooms emerges in an environment in which students interact and struggle with mathematics. This vision of a math student-centered learning environment details performance outcomes for students and educators (Brodie, 2016). Because the development of conceptual understanding and procedural fluency determines elementary students' math proficiency, effective PD must focus continually on addressing the vision of student-centered learning of number sense so that students are using their ideas and strategies to associate mathematics with the world around them (Wang, 2014). Once the PD leadership sets priorities for the school year, one of the PD developer's roles must include planning that helps teachers develop a vision that will serve as a road map of the process (Martin, 2016). In addition, the professional developer helps design collaborative PD opportunities guided by data, ensures that those learning understand why PD is necessary, serves as a nurturer and/or coach by listening and taking in data points, and acts as the heart of change so that the change is easier. In short, PD leadership works to lead and facilitate change in others' practices (Neuman, 2014).

Implications

TXSD's Five Year Strategic Plan defines the districts' planning criteria for teachers to facilitate lessons that are organized, student-centered, and founded on clear objectives. The planning criteria include three teacher practices: (1) develop student learning goals; (2) collect, track, and use student data to inform instruction, and (3) design effective lesson plans, units, and assessments. One of the first tasks during the initial PD sessions is to guide each teacher through the design of student performance goals based on each student's cognitive stage of development as identified in their performance and demographic data (DeKem, 2014). Once student performance goals are established, additional collaborative PD tasks afford teachers the opportunity to teach mathematics profoundly by integrating new and existing knowledge structures through a variety of instructional approaches (McGee et al., 2013).

In addition to Guskey's model (2017), Steeg (2015) argued that PD's features are most effective when they influence teacher knowledge and practice. He suggested a set of core features common to effective PD that supports teacher change: focus on subject matter content; active teacher learning; coherence with knowledge, belief, and school reform policies; offered for an extended period, and collective participation as an interactive community. Pursuant to this study, both Guskey and Steeg (2015) argued that a common feature that affects teacher change in instructional practices includes consistent teacher participation in PD. Further, they argued that teachers who learn through a variety of PD experiences over time improve their knowledge and practice.

PD in TXSD occurs weekly at every campus during the school year. Elementary campuses in TXSD implement campus-wide PLCs, mentor/mentee programs, instructional coaching, and specialist-led content planning sessions as part of the district's PD initiatives. Professional learning experiences include tools and practices for the constructivist teacher, such as modeling and coaching in question and answer periods after each skill, executing balanced assessment practices, and helping teachers create a learning experience that allows students to explore concepts freely while the teachers provide opportunities for them to apply new math skills to meaningful, real-world experiences (Anderson, Cooper, Nason & Stutz, 2017). This study potentially could inform a project in which district leaders learn about the relationship between the number of math content and process PD courses taken and the implementation of the strategies learned. With this, they would be able to identify the number and types of PD sessions necessary to improve teacher practice and, thus, student achievement. The project had a tentative direction as a district-led PD initiative for TXSD elementary math content teachers to teach local stakeholders the purpose, goals, and learning outcomes of the district-led math process and content PD. In addition, the elementary mathematics PD initiative could have outlined the PD components with timelines, activities, session materials, training notes, and an implementation and evaluation plan. However, because of the lack of significance the analyses revealed, the policy recommendation chosen speaks to a process to reveal different aspects of PD that inhibit effectiveness, specifically methods of PD design, implementation, and evaluations.

Summary

Traditional teacher PD experiences have failed to meet the demands required to achieve the new math standards in elementary classrooms. Despite the heightened sense of urgency to implement new math standards and instructional models to teach elementary math concepts, those who develop and deliver PD programs continue to resort to comfortable and familiar approaches. This study performed a series of correlations to investigate the direction and strength of the relationships between student achievement and teacher attendance in elementary mathematics PD programs the TXSD district offers. This section introduced PD and its significance for student achievement. The problem was explained together with information on the way it affects a local school district. The section included a synthesis of the literature related to PD in math skills and effective math instruction within the study's theoretical framework. Section 2 presents the research methodology that was used in this study. The research design and approach are presented together with a description of the setting, sample, and data information. The policy recommendation project is introduced in Section 3, together with a review of the literature that supported it. Finally, Section 4 includes a reflection on the project development process.

Section 2: The Methodology

Research Design and Approach

To answer the research questions, a correlational design was employed to determine whether the variables investigated (number of content and process courses attended [dosage], T-TESS implementation score, and student achievement) are related. The strength and directions of the relationships between the number of PD courses attended, T-TESS implementation scores, and student performance on the STAAR for mathematics were reported as correlation coefficients. Scores from this analysis fall along the correlation coefficient's line of best fit from -1.00 to 1.00, in which 0 indicates no relationship. A bivariate correlational design addressed the research questions best, as the problem required identification of the direction and degree of association among four different sets of variables: the number of math content PD sessions teachers attend, the number of math process sessions attended, T-TESS implementation scores, and math achievement scores. A bivariate correlation is designed to determine whether and the way in which two continuous variables are related (Creswell, 2014). The number of PD sessions was measured on a ratio scale, whereas the variables of the implementation scores and student STAAR scores were measured on an interval scale. During each T-TESS observation, each teacher received a mean performance rating in each of the four domains: planning, instruction, learning environment, and professional practices and responsibilities. Performance in each domain was rated on a 5-point scale, averaged, and then assigned a single rating.

Setting and Sample

The target population for this study was TXSD's third grade teachers and their students' scores. Eligibility criteria for study participants were third grade teachers who taught math content in TXSD during the 2015-16 school year. Exclusion criteria included non-third grade teachers and those who taught outside TXSD during the 2015-16 school year.

With respect to the sample size, Table 1 presents the power analysis conducted using Creswell's (2014) *G*Power 3.1: Tests for correlation analyses*. For a power calculation of 0.95, a sample size of 115 teachers was required, which was appropriate because the data already conformed to the study's purposes, and the file contained the data for all 120 teachers.

Table 1

Correlation: Bivariate Normal Model Analysis

Analysis	A priori	Compute required sample size
Input	Tail(s)	1
	Correlation ρ H1	.30
	α err probability	.05
	Power (1-β err probability)	.95
	Correlation ρ H0	.00
Output	Lower critical r	.15
	Upper critical r	.15
	Total sample size	.115
	Actual power	.95

Note. Calculations were based on recommendations from Faul, Erdfelder, Buchner, and Lang (2009).

Instrumentation and Materials

The student performance data were the elementary students' mathematics scores on the STAAR, which was designed to measure individual student progress in content that is associated directly with the Texas Essential Knowledge and Skills (Texas Education Agency, 2016). The questions on the STAAR are consistent with the Texas Essential Knowledge and Skills for the grade specific subject. The STAAR is a timed assessment administered in a paper format in the spring of each school year for third through fifth grade mathematical content standards.

The basic score on the STAAR is a raw score of the number of questions correct. The raw scores can be interpreted only with the particular set of test questions. For example, STAAR Grade 3 Mathematics includes 46 questions that report three proficiency levels based on the student's raw score: Level 1-Unsatisfactory, Level 2-Satisfactory, and Level 3-Advanced. If the third-grade student's raw score falls between 0-23, his or her proficiency level is unsatisfactory. If it falls between 24-40, the student's proficiency is satisfactory, and if it falls between 41-46, the student's proficiency level is advanced. Unlike raw scores, scale scores allow direct comparison of student performance across different test administrations. A scale score entails converting the raw score to a scale that is common to all test forms for that assessment. STAAR results report performance of students' scale scores and the percentage of students who meet the standard or minimum expectations across administrations of the assessment.

The method used to verify the STAAR's reliability included multiple assessments administered to the same student sample during one test administration. Reliability is the extent to which a test's results are consistent across test conditions, such that repeated administration of an identical assessment yields consistent results (Creswell, 2014). Reliability is a critical attribute of any measurement instrument, because unreliable scores cannot be interpreted effectively. Internal consistency reliability is an important consideration and is the type of reliability that is analyzed typically for large-scale educational assessment scores. This type of reliability estimates how well a collection of test items within the same domain are related to each other. For the primary STAAR English and Spanish Assessment administered, the internal consistency estimates ranged from 0.81 to 0.93. Internal consistency estimates across grades and content areas were found to be of a similarly high level, with no noticeable increases or decreases across grades or content areas.

Validity measures the degree to which a test assesses what it is intended to assess. According to the Texas Education Agency, STAAR scores are intended to represent what a student knows and can do in relation to his or her grade level. Evidence of validity includes demonstration that each grade level test has a strong association with grade level curriculum requirements defined by the Texas Education Agency standards for each grade. When compared to scores for prior grades, STAAR grade scores are intended to indicate how much students have learned since the previous grade and what they are likely to achieve in the future (Texas Education Agency, 2015). The STAAR results are used to make inferences about students' knowledge and understanding of the Texas Essential Knowledge and Skills. Therefore, test makers are responsible for collecting evidence that supports the scores' intended interpretation and uses. Test scores for the teachers in the sample were accessed via the district's data management system, "Euphoria." The students' scores were used to determine the relationship between the independent variable, the number of math content and process PD courses teachers attended, and the dependent variable, third grade student performance data from the STAAR state assessment.

In addition to the data from STAAR scores, the T-TESS was also a part of this study. As discussed previously, TXSD implements the T-TESS as part of the district's formal teacher evaluation cycle. T-TESS includes observations and walkthroughs using the rubric's four domains (planning, instruction, learning environment, and professional practices and responsibilities) and includes 16-dimension descriptors that establish a common language for evaluation.

Data Collection and Analysis

A meeting was held with the district's executive director of accountability to request access to the student performance raw data scores, teacher PD attendance, and T-TESS implementation scores. All data were obtained subsequently from the district's Research and Accountability Department data management system. The director of research was asked to generate a data file of the dataset. The study's findings are presented in three sections. The first describes the research site conditions and data collection procedures. The second describes the data collected, and the third summarizes the results of the correlation analysis and explains the results.

Description of Data Collection Conditions

The data used for this study were provided after formal research study approval from the research site's Research and Accountability Department. The department granted access to the data management system from which the following data were extracted: number of PD courses each teacher attended, T-TESS teacher implementation scores, and students' STAAR performance scores. Student scores on STAAR are reported as scale scores. The number of math PD courses teachers attended ranged from 0 to 36.

The district offered a variety of PD sessions both after the school day and at Saturday workshops. Of those offered, multiple sessions addressed math content and process for elementary teachers. For the purposes of this study, data were extracted for two specific sessions: math content and process PD sessions, both of which began in August and ended in April of the 2015-2016 school year. The process PD sessions addressed instructional approaches for teaching Grade 3 math concepts such as cooperative learning structures and problem-solving instructional approaches to strengthen math pedagogical content knowledge. Content PD sessions addressed deconstructing state math standards to strengthen students' math content knowledge. PD attendance was recorded at each session; a member of the district's PD department collected each attendance sheet and awarded PD credit hours to each teacher within 48 hours of the session's completion. All PD session attendance data for all staff members are kept in the district's data management system. Once data were extracted from the system, they were compiled with Microsoft Office Excel. The research site's data analysts provided all data for collection purposes in one password-protected data file. The first data file included only one of the four data points requested. After the second request, the analysts provided the remaining three data points in three different data files. All four data points then were entered into one password-protected file in preparation for analysis.

SPSS was used to perform the correlation analyses. After the raw data were entered in the program, the dependent variable of student performance scores was correlated with the independent variables of the number of process and content PD's attended, and T-TESS implementation scores. T-TESS scores also were correlated with the number of process and content PDs attended. The data were entered in one Microsoft Excel file, after which the dataset was filtered to include only the variables needed to conduct the analysis. The descriptive analysis included pairing sample data consisting of student scores on the Elementary Math Grade 3 STAAR Assessment with the number of math content and process PD courses teachers attended and T-TESS implementation scores. The data revealed that only 34 third grade teachers met the criteria of PD attendance, T-TESS scores, and student outcome STAAR scores.

The *r*, the linear correlation coefficient, or the Pearson product moment correlation coefficient, represents the strength and direction of a linear relationship between two variables (Seigle, 2015). The value of *r* was calculated using two variables at a time, and then the coefficient was used to report the strength and direction of the correlation. The correlation analysis was conducted via the five steps of hypothesis testing: (a) identify null and alternative hypotheses, (b) set the alpha, (c) collect the data,

(d) compute the sample statistic, and (e) decide whether to reject or accept the null hypothesis (Creswell, 2018). The correlation was considered statistically significant if p was < 0.05, which indicates that it is unlikely that the relationship is attributable to chance. The direction and strength of the correlations were summarized numerically using the r to determine their size and strength, respectively (Triola, 2017). The correlation measures the degree of relationships while squaring the correlation (R^2), which is the coefficient of determination, measures the relationship's strength. R^2 assesses the proportion of variability in one variable that a second variable determines or explains (Creswell, 2014). In this study, the R^2 expressed the magnitude of the association between the variables as the effect size, which is another way to assess the relationship's magnitude (Creswell, 2014).

The Pearson product moment correlation r was used to measure the strength of the linear association between: (a) the number of math content PD third grade teachers attended and student scores; (b) the number of math process PD attended and student scores; (c) the number of math content PD courses attended and T-TESS implementation scores; (d) the number of math process PD courses attended and T-TESS implementation scores, and (e) T-TESS implementation scores and student achievement scores measured by STAAR. After the correlations between each pair of variables were calculated, the strength of the relationships was determined.

Assumptions, Limitations, Scope and Delimitations

The results from this study may inform the practice of current elementary mathematics PD and help professional developers determine what they can do to further support teacher learning during PD experiences. In the study, it was assumed that various types of educational PD training in elementary mathematics instruction influenced teachers' ability to increase student achievement. Further, researchers argue that the size of the correlation generally is unstable in small samples. Perugini and Schonbrodt (2013) asserted that the sample size should be 250 persons to achieve stable estimates. As the sample size was less than 40 participants, it was assumed that a correlation would demonstrate a relationship regardless of the small sample size.

The study was limited, in that it included a small sample of only 34 third grade teachers in one Texas school district, which has specific student and teacher measures on which the variables were based, as well as the type of PD courses. Other potential limitations of the study may have been general in nature, such as inadequate measures of the quality of teacher training, that could make it difficult to generalize the findings to other teachers or situations. There may have been a number of implicit assumptions underlying student achievement in addition to teacher participation in PD, such as influences from family or prior schooling. The delimitations of this study were that the data derived from one grade level, and were collected only on teachers' attendance in district-led, face-to-face math PD sessions for one school year, and state elementary mathematics student achievement assessment data from that same year. The parameters did not include data from attendance at any other PD. The primary question in which district leaders are interested is whether their new PD opportunities have a positive influence on students' elementary mathematics STAAR scores.

Protection of Participants' Rights

A total of 34 participants of a total of 115 third grade teachers from the research site had data for all four variables. Permission was obtained through a formal letter to the district's PD department that detailed the purpose of the study, the way in which the study's results would be used, specific study activities that would be conducted, the study's benefits to TXSD, and the provisions made to protect the study participants' anonymity (Creswell, 2014). The District's Office of Accountability provided de-identified data that preserved both the teachers and students' anonymity.

Data Analysis Results

Teachers' ability to develop conceptual understanding of mathematics is very important, as one accepts that deeper, more cohesive learning experiences are necessary to promote student math learning in new and innovative ways (Knipe & Speck, 2005). The goal of this study was to have teachers achieve a better understanding of mathematical content by engaging in both math content and pedagogical process PD. This study was based on the premise that by participating in PD, teachers were challenged and motivated to embrace new approaches to teach elementary mathematics. The intent of the PD was for teachers to examine their critical math content and processes to become more skilled and confident as mathematics teachers.

Descriptive Results

Student performance data measured by STAAR scores ($N = 34$) had an average mean scale score of 1384 (see Table 2). Process PD data ($N = 34$) indicated that third grade teachers attended an average of three process PD sessions ($s = 2.08$) during the

2015-16 school year (see Table 3). Content PD data (N = 34) indicated that third grade teachers attended an average of three content PD sessions (s = 2.46) during the 2015-16 school year (see Table 4). T-TESS scores for Domain 4 during the 2015-16 school year (N = 34) averaged 3.12 (s = 0.42; see Table 5).

Table 2

Descriptive Analysis of STAAR Scores

	N	Minimum	Maximum	Mean	*SD*
STAAR	34	772.00	1559.00	1384.71	128.64

Table 3

Descriptive Analysis of Process PD Scores

	N	Minimum	Maximum	Mean	*SD*
PROCESS PD	34	.00	8.00	3.06	2.09

Table 4

Descriptive Analysis of Content PD Scores

	N	Minimum	Maximum	Mean	*SD*
CONTENT PD	34	.00	9.00	3.00	2.46

Table 5

Descriptive Analysis of T-TESS Scores

	N	Minimum	Maximum	Mean	*SD*
TTESSPD	34	2.25	3.00	3.13	.42

Correlation Analyses

The results of the strength and relationship between student achievement as measured by STAAR, learning, and mathematics instruction varied, but none was significant. Table 6 illustrates the correlations among the four variables, including process and content PD hours, T-TESS implementation scores and student achievement scores.

Table 6

Correlation of Professional Development, Learning, and Student Achievement

		STAAR	TTESS	CONTENT PD	PROCESS PD
STAAR	Pearson Correlation	1	.19	-.14	.11
	Sig (2-tailed)		.28	.44	.54
	N	34	34	34	34
TTESS	Pearson Correlation	.19	1	-.04	.17
	Sig (2-tailed)	.28		.81	.33
	N	34	34	34	34
CONTENT PD	Pearson Correlation	-.14	-.04	1	.51**
	Sig (2-tailed)	.44	.81		.00
	N	34	34	34	34
PROCESS PD	Pearson Correlation	.11	.17	.51**	1
	Sig (2-tailed)	.54	.33	.00	
	N	34	34	34	34

Note. ****** Correlation is significant at $p < 0.01$ level (2-tailed)

Research Question 1: What is the direction and strength of the relationship between the number of math content PD courses attended and student achievement scores on STAAR?

To address this question, the number of content PD courses teachers attended was correlated with the dependent variable, student achievement scores on STAAR and a bi-variate correlation was used to assess that relationship. The correlation coefficient *r* was -0.14, indicating that the number of math content PD courses teachers attended predicted less than 1% of student outcome scores, and thus indicated only a weak negative relationship between the variables. Thus, the null hypothesis was not rejected at $p < 0.01$.

Research Question 2: What is the direction and strength of the relationship between the number of math process PD courses attended and student achievement scores measured by STAAR?

To answer question 2, the number of process PD courses teachers attended was correlated with the dependent variable of student achievement scores on STAAR and a bi-variate correlation was used to compute the relationship. The correlation coefficient was 0.11, indicating a weak positive relationship in that the number of process PD courses teachers attended predicted that 1% of student outcomes scores Therefore, the null hypothesis was not rejected at $p < 0.01$.

Research Question 3: What is the direction and strength of the relationship between the number of math content PD courses attended and T-TESS scores?

To address this question, the number of math content PD courses teachers attended was correlated with T-TESS implementation scores and a bi-variate correlation was used to compute and describe the relationship. The correlation coefficient was -.04, indicating that there was only a weak negative association between the two variables. Thus, null hypothesis is not rejected at $p < 0.01$.

Research Question 4: What is the direction and strength of the relationship between the number of math process PD courses attended and T-TESS scores?

To answer this question, the number of process PD courses teachers attended was correlated with T-TESS implementation scores and a bi-variate correlation was calculated to measure this relationship. The correlation coefficient was .17, indicating that the number of process PD courses teachers attended predicted less than 1% of student outcomes scores, and thus, there was a weak positive relationship between the two variables. Therefore, the null hypothesis was not rejected at $p < 0.01$.

Research Question 5: What is the direction and strength of the relationship between T-TESS scores and student achievement scores on STAAR?

To address question 5, T-TESS implementation scores were correlated with student achievement on STAAR, and the bi-variate correlation described the relationship between the variables. The correlation coefficient was .19, indicating that T-TESS implementation scores predicted less than 1% of student achievement. Therefore, null hypothesis was not rejected at $p < 0.01$.

As none of the null hypotheses were rejected, an ad hoc power analysis, Creswell's (2014) *G*Power 3.1: Tests for Correlation Analyses* (Table 7), was conducted to gauge the effectiveness of the hypothesis tests and minimize the probability of a Type II error. The power was computed using a significance level of .05 to ensure a power of .95. The power results indicated that a sample size of N = 34 teachers was necessary for an exact power calculation of .99, which is higher than the power of .95 requested. Thus, 34 teachers were an appropriate sample size. According to Triola (2012), a power of at least .80 is a common requirement to determine that a hypothesis test is effective and can be used to determine the minimum sample size required (Triola, 2012).

Table 7

Correlation Point Biserial Model

Analysis	Post hoc	Compute achieved power
Input	Tail(s)	1
	Effect size (*p*)	.71
	α err probability	.05
	Total sample size	.34
Output	Noncentrality parameter	5.83
	Critical *t*	1.70
	df	32
	Actual power	0.10

Note. G*Power 3.1: Tests for correlation analyses, Faul, Erdfelder, Buchner & Lang (2009).

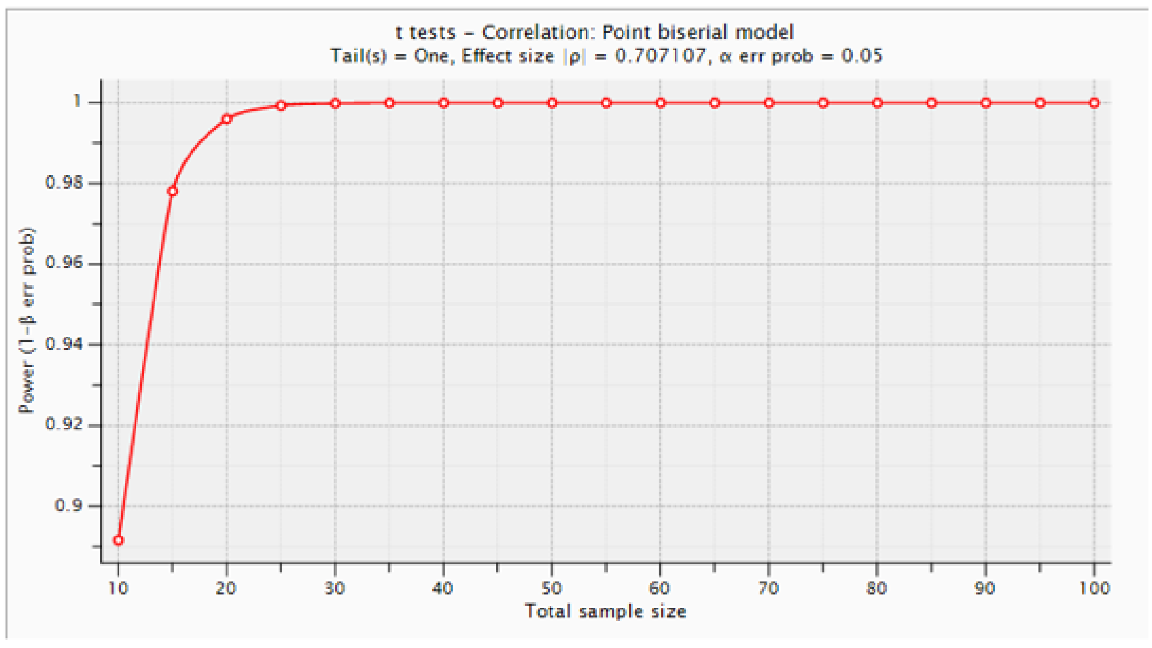

Figure 1. Point biserial model.

Overall, none of the five research questions' hypotheses were supported, as all correlations among the variables were extremely weak. The strength and direction of correlations between each pair of variables was made based on the theoretical framework of Guskey's Model of Teacher Change which highlights three major outcomes of PD, teachers change their classroom practices, perceive evidence of improved student learning, and change their beliefs accordingly. However, this correlational study failed to find any significant associations among these variables.

Explanation of the Results

A teacher's mathematical content knowledge and evidence-based instructional practices affect student learning significantly. According to Weber (2015), a teacher's ability to understand mathematics and the way various math concepts interconnect enhances the teacher's ability to teach math concepts in a way that responds to student learning (Weber, 2015). A teacher's ability to understand the mathematics they are asked to teach creates a learning environment in which they use instructional practices regularly, including questioning to clarify thinking, challenging misconceptions, and providing informative feedback in real time.

The goal for teachers who experienced math content and process PD at the research site during the 2015-16 school year was to achieve increased mathematical content knowledge and mathematics pedagogical content knowledge. The role of math content PD staff was to work with teachers to strengthen their knowledge of third grade math content. Each PD session focused on a specific math domain (Numbers, Operations, Geometry, Measurement, and Data Analysis). Third grade teachers who attended math content sessions were to deconstruct each math standard by domain. Once they understood the standard's content expectations, each participant worked and analyzed example problems within each standard and domain to apply his or her newly acquired content knowledge. However, the data analysis revealed no relationships among the variables tested. The research site's policies involved in math PD design, implementation, and evaluation may have contributed to the absence of relationships among the variables.

One factor that the research sites' PD policy lacked was that it failed to include the third-grade teachers in planning, implementing, reviewing, and revising the PD design and outcomes. The district assessed the teachers' and students' needs to determine the math content and process PD goals, but teachers were not included in executing the PD design and working on session outcomes during that school year. Instead, the district used several statistics to inform PD goals, and hired outside experts to plan, implement, review, and revise the PD design and implementation. Guskey (2017) suggested that embedding PD in teachers' real work provides a clear connection to their teaching. Because the research site did not engage teachers in PD designs, they did not focus on the teacher learner as part of the process.

The district's PD policy also failed to include methods to sustain growth in the math content and process PD designs, goals, and/or session outcomes overall during the 2015-16 school year. As external experts were hired to facilitate all math content and process PD, and did not conduct walkthroughs or evaluations to monitor implementation of instructional models newly-acquired, the implementation of new learning was not supported. The research site could have included in its policy such supports as on-going instructional modeling of new learning, instructional coaching practices based on new learning, and collaborative work in teacher teams and/or PLCs to solve instructional issues related to new learning.

Conclusion

As the study investigated the relationships among the number of hours teachers attended elementary mathematics PD, implementation of strategies learned in PD, and elementary student's math STAAR scores, SPSS was used to conduct the analyses. Statistical correlations were appropriate for this particular study, as they assessed the relationships between/among the variables measured. The data collected in this study included STAAR test scores from TXSD elementary math students, teacher implementation scores from the T-TESS, and teachers' participation in mathematics content and process PD activities. The correlation coefficient between each pair of variables was calculated to test the null hypothesis that there is no correlation between the variables in the population from which the sample was drawn.

Section 3: The Project

Introduction

This quantitative, correlation study was conducted to measure student performance and evidence of math instructional practices of a group of elementary teachers acquired through math PD participation. The results yielded an insignificant relationship between student performance on STAAR and PD participation, so the null hypotheses were not rejected. As a result, the outcomes of the data analysis failed to confirm that teachers' PD experiences effected changes in their instructional approaches, behavior, and attitudes because of ineffective PD implementation. Accordingly, the project's policy recommendation will provide the district with an option to strengthen the research site's PD design, implementation, and evaluation.

The policy recommendation detailed in this section reveals different aspects of PD that inhibit its effectiveness, specifically the methods used to design, implement, and evaluate it. Educators who do not demonstrate changes in their instructional practices and beliefs and witness evidence of student achievement after they experience PD may believe that PD does not have a clear purpose or at least one that they recognize (Guskey, 2017). When an educator understands why he or she is engaging in PD, the experience tends to be more effective, whereas PD with no clear intent may lead to neglect to engage in a valid and useful evaluation process.

Rationale

A policy recommendation can be made to examine, analyze, and evaluate a program further to reveal the different aspects that inhibit its effectiveness when teachers do not benefit the same way regarding their practices and beliefs as well as student achievement (Todd, 2017). The policy recommendation in this study includes specific attributes of the PD design to ensure its consistency with session outcomes and district goals. The policy recommendation stipulates that all math PD sessions include outcomes with specific language that is consistent with the district goals. Elements of high-quality PD include establishing accountable goals that are compliant with standards (Brussow, Erickson, Gaumer, Noonan, & Supon, 2017).

This policy recommendation project also includes processes to measure teachers' self-efficacy before and after the PD experience. The research site did not include a PD policy to assess participants' beliefs and attitudes about the PD session before and after the session concluded. Because PD emerges from teachers' expressed needs, a direct connection must be established between these needs and the students' achievement levels (Gaumer et al., 2017).

Lastly, this policy recommendation project will best support the results of this study with recommendations to train and prepare school personnel who evaluate teachers' changes in instructional approaches. As Guskey's (2017) theoretical framework suggests, effective PD results in changes in instructional approaches. The school district on which this study was focused requires resources to strengthen the process to measure implementation of instructional practices, and a policy recommendation project will provide these suggestions.

Review of the Literature

This policy recommendation can be used to examine, analyze, and evaluate the design and implementation of the current PD practices to determine its effectiveness, specifically elements that relate to student achievement. The review of literature includes educational policy research on changes in teaching practices—most importantly those that embody classroom discourse and effective curriculum implementation and occur with development of teacher beliefs that support student-centered teaching of mathematics and instructional pedagogies. Search terms were selected to conduct a review of effective PD design and student achievement: *private and public policy, educational policy*, *teaching self-efficacy*, *teacher beliefs* about student-centered instruction, *job-embedded professional development*, and *instructional coaching*. Efforts to select appropriate literature on educational policy and its implication for teacher PD and instruction was purposeful and focused. The literature review encompasses policies with several perspectives on PD design and implementation to determine its effectiveness related to student achievement. In addition, this literature review includes policy research on teachers' beliefs about student learning of mathematics, processes to develop PD through job-embedded PD methods (JEPD), and its implementation with campus-based instructional coaching processes.

Policy

Policy can be defined as a set of rules or guidelines formulated and enforced by an organization to direct and limit its actions in pursuit of long-term goals (Web Finance, 2019). These policies are generally available through a booklet or other accessible format

(The Business Dictionary, 2019). In other words, policies are standards or rules developed and implemented by organizations (public and private) to govern and guide the organization to reach its goals. Policies are adopted by an organization and policy recommendations are written products developed by a group in position to administer the decisions and presented to an organization for adoption. With regard to education, policy recommendation is created and implemented in response to educational issues (Gasior, 2017).

In addition to policies, organizations develop procedures to implement policies, which help guide decisions and achieve outcomes. Procedures are protocols in the form of a statement of intent or statement of actions to be taken by the organization to implement its policies; they are the steps or actions enacted by the organization. In other words, procedures define the boundaries of how to implement the policy (The Business Dictionary, 2019). In summary, both private and public organizations develop and implement policies and procedures to govern and manage the operations of the organization to achieve long-term goals.

Most policies can be classified as principles that govern public or private organizations. The structure of a policy recommendation is developed with identifying an issue that requires a policy decision (Doyle, 2013). Whether a public or private organization or entity, there are several stages involved in developing policies. Organizations must first identify a need for the policy. To do so, the organization gathers data and information, drafts a policy, seeks stakeholder consultation, and approves or adopts the policy. Next, throughout the process, revisions to the original policy may be drafted. Finally, organizations delegate responsibility for the implementation of the policies. Connected with policy development, organizations draft and adopt delineated procedures for implementation, which may include an evaluation method to assess the effectiveness of the implementation of the policy.

In summary, policies are developed by both private and public entities to govern their organization. Many types of organizations (e.g., corporations, foundations, colleges and universities, and K-12 educational institutions) both public and provide are governed by policy. For the purpose of this research, the purpose and development of public policies will be discussed.

Public Policy

Public policy is not subject to democratic processes (Aja, 2018). Public policy is created outside of corporate or company rules and regulations. This distinction is best made according to the lines of formal ownership. Public policy is created in the open with and has the force of law, and some public policy may be considered law. The Center for Civic Education (n.d.) defines public policy as "what government (any public official who influences or determines public policy, including school officials, city council members, county supervisors, etc.) does or does not do about a problem that comes before them for consideration and possible action" (para. 1). Public policy may be developed by federal, state or local governmental entities or agencies and

1. is a governmental response to an issue or problem and to find a solution to the issue or problem,
2. may come from outside the governmental entity,

3. may be a law or regulation to govern the response to an issue or problem,
4. is developed on behalf of the public, and
5. is an ongoing process. (Civic Education, n.d.)

With regard to public policy, legislation may be defined as a law, whereas regulation is considered the way the legislation (law) is implemented (Penn State, n.d.).

Public Education Policy

The major objectives of public education policy are to provide information on a variety of opportunities, define educational outcomes to the public, inform debate on important education issues, and promote equal educational opportunity for all (Coley, 2017). Using research and evidence to support the resolution to an issue defines how policy recommendations are used to manage systems such as education agencies. In the United States, public education policy can be developed and implemented at the federal, state, and/or local level. In the United States, public educational policy serves two main purposes. First, public education policy provides guidance for all public education agencies to afford equal access to a quality education for all students. Second, these policies help ensure the economic future of America remains competitive in the global marketplace of the 21st century (Feng, 2019).

Although education, especially public education, has been in existence for a long period of time, policy recommendations drafted to address issues arising in education were not documented until the mid-20th century. Issues and problems in education that prevented individuals from becoming effective contributors to a global society were not addressed in the early years of public education. Some of the first organizations that addressed issues arising in education affecting student learning were the formation of the United Nations Education and Cultural Organization and Universal Declaration of Human Rights during the mid-20th century (Green, Lingard, Mundy, & Veger, 2016). The establishment of these organizations launched a new era for policy making in education, which worked to influence transformation throughout the schooling systems (Mundy et al., 2016).

Across the nation, schools and school districts have since developed public policies. Some policies are mandated by federal, state, and local legislation and regulation. For example, the No Child Left Behind (NCLB) and the Individuals with Disabilities Act are examples of federal policy enacted in public schools. NCLB is a federal law passed in 2001 that established new expectations for funding and accountability structures in public education and regulates public education in schools in the United States that receive federal money. NCLB is considered the first federal legislation in which the federal government held states accountable for improving student achievement, which was done to close the achievement gap. One element of this public policy includes an accountability system where all public-school districts are required to make “adequate yearly progress” on benchmarks of student achievement, with the results publicly available through an annual report card (Ruff, 2019). Schools that did not meet adequate yearly progress would be labeled “failing,” giving parents the choice of transferring their children to a different school. NCLB also required that every state develop standards for reading and math curriculum and assessments to measure if students achieved the standards at different proficiency levels. The goal was that all students in public schools in the United States would achieve at least at proficiency level on state assessments in reading and math by 2014 (Hodges, 2018). To achieve this goal, NCLB included requirements for hiring highly qualified teachers in response to low performing schools were more likely staffed with uncertified teachers. Prior to this federal legislation (policy), states and school districts spent billions of federal dollars without accountability and persistence of unacceptable levels of student achievement. The intent of the federal legislative policy was to hold schools and school districts accountable for increased student achievement.

Every Student Succeeds Act is another example of educational policy. The act was a policy signed into law in 2015 by President Obama. This policy reauthorized the Elementary and Secondary Education Act of 1965, which was an education law that defined how schools in America would provide equal opportunity for all students (Fusarelli, 2019). This is a reauthorized act of the original legislative policy expanding on accountability and increased student achievement by addressing different progress measures made possible by educators, communities, and parents (Saultz, 2019).

In response to federal legislation (policy), states and local school districts develop policies to comply with federal legislation. Additionally, states may enact legislation in response to a specific issue or problem. For example, after the mass shooting at Parkland High School in Florida, the Florida State legislature passed the Marjory Stoneman Douglas High School Public Safety Act, allowing teachers with firearm training to carry firearms in schools (Florida Department of Education, 2018). Consequently, school districts in the state developed local policies to comply with state legislative policy.

Furthermore, public schools develop specific local policies to guide the operation of the school or school district. For example, in 1996 and revised in 2012, the state of Texas developed Framework for School Board Development. The Framework outlines the vision, structure, accountability, advocacy, and unity needed to provide local educational programs and services that will promote excellence in student academic achievement (Texas Education Association, 2014). The Texas State Board of Education is the state public governmental entity that establishes policy for Texas public schools. The board includes elected members and a gubernatorial appointed chair. Its primary responsibilities are to:

1. Set curricular standards
2. Review instructional materials
3. Establish graduation requirements
4. Oversee of the Texas Permanent School Fund
5. Appoint of board members to special districts (military reservations and special school districts)
6. Conduct final review of proposed certification rules
7. Conduct review of the commissioner’s proposed new charter schools. (Texas Education Association of School Board, n.d.)

Additionally, local districts are required to develop policies for their board policy manual in the following seven areas: basic district foundations, local governance, business and support services, personnel, instruction, students, and community and governmental relations. Furthermore, there are four types of documents that may be included in the local district policy manual:

1. Legal policies. These are policies that are associated with and support current law. Legal polices are not required to be approved by the local board.
2. Local policies. Local policies are approved by the school board and address local issues such as attendance, transportation and open-closing times policies. Local policies govern how the district operates or the "what" that needs to be done.
3. Local regulations. Local regulations are developed by administrators and regulate or control "how" the work of the district will be accomplished.
4. Exhibits. Exhibits include the documents that are used to implement policies and regulations. (Texas Education Association of School Board, n.d.)

In conclusion, policy recommendations provide guidance and regulations for resolving issues that arise in both public and private industries. This project study includes a policy recommendation project that responds to a school district's guidelines governing PD. The following is a review of literature from elements of this project study's policy recommendation which serves as evidence for resolving issues involving effectiveness of PD and student achievement.

Teacher Self-Efficacy

Processes that measure teachers' self-efficacy before and after PD involvement will strengthen PD design and implementation. Changes in teachers' beliefs about learning have been considered most valuable when changing classroom instruction.

Guskey's (2017) model demonstrates the importance of staff development that works to respond to teachers' beliefs to effect changes in their instructional practices. Teachers' beliefs about what makes an effective mathematics teacher are related to their instructional decisions, and Guskey's model indicates the consistency between changes in teachers' beliefs and teaching practices.

Polly and colleagues (2017) conducted a study of kindergarten teachers to determine the way support with a curriculum-based PD program related to student achievement. They explored the literature and identified that teacher characteristics that are consistent with effective instruction and student achievement: content knowledge, beliefs about mathematics teaching and learning, and knowledge of pedagogical content. In addition, the authors determined that knowledge of content, pedagogy, and beliefs are characteristics that influence the use of effective instructional strategies. The study employed a pre- and post-project questionnaire to evaluate teachers' beliefs, practices, and content knowledge. The post-project results demonstrated statistically significant changes from transmission to discovery/connectionism in participants' beliefs both about math as a subject and about teaching math.

Research has identified three distinct aspects of a teacher's belief system with respect to teaching mathematics (Polly et al., 2013): (1) a teacher who transmits mathematics is one who believes that math is a set of facts presented with teacher-centered methodologies; (2) a discovery mathematics teacher believes that math includes knowledge that is learned best through student exploration; and (3) a connectionist mathematics teacher relies heavily on experiences and real-life connections to help students learn math concepts. According to the authors, teachers' beliefs must embrace a discovery and connectionist perspective to provide student-centered and standards-based instruction.

They further stated that teacher beliefs that support student-centered math learning are likely to lead to better student outcomes than are those that support teacher-centered instruction. Student-centered learning emphasizes that students learn mathematics content at high levels when the learning includes experiences with guided exploration and is connected to the student's real-life experiences. Students' progress through a mathematical learning continuum when connections are created between different math topics. Polly and colleagues (2013) correspondingly stated that teachers who demonstrate a belief in learning mathematics that is student-centered must engage in PD that embraces student-centered instructional approaches that engage adult learners in PD about math teaching and the way students learn mathematics using a discovery or connectionist approach. According to the authors, students with teachers who embrace student-centered instructional approaches to mathematics are expected to achieve better performance on their math post-tests compared to pre-tests than those who have teachers with teacher-centered beliefs about learning mathematics. Based, in part, on their work, this project will include a strategy to determine mathematics teachers' beliefs and use these data to develop a revised district PD design and implementation program.

Buether, Hur, and Jean (2015) asserted that teachers' beliefs, attitudes, and perspectives are a focus of student performance. The authors conducted a study on the consistency between teachers' beliefs and student academic achievement in early childhood classrooms. They collected data on teachers' student-centered beliefs and student achievement using the Modernity Assessment Scale to determine which teachers used a student- and which used a teacher-centered approach to instruction. The authors maintained that it is the teachers' role to be aware of, and responsive in, their instructional practices to students' learning processes rather than enforcing teacher-centered rules and limits on student learning. Their results indicated that students with teachers who reported more student-centered beliefs about learning mathematics had higher math scores, indicating the need for PD programs that focus on soliciting information about teachers' beliefs in the PD design process.

Kleickmann et al.'s (2016) study on science PD's effects on teacher beliefs and motivations, instructional practices, and student achievement also measured PD's effectiveness in altering elementary teachers' beliefs and motivations for learning. The researchers investigated whether, and the way in which, changes in instructional beliefs changed elementary science teachers' participation in PD experiences. The authors agreed that restructuring teachers' beliefs about instruction is a critical component of PD design and implementation, and that PD programs create opportunities that nurture content knowledge growth and strengthen learning of pedagogical approaches, but fail to modify teachers' beliefs about learning that produce significant changes in instructional practices and student learning.

Ida (2017) focused on teacher, school principal, and student beliefs in his study of good teachers' attributes. Before the study, the author conducted a literature review based on which he created a list of attributes that described a good teacher and included (1) teacher personality, and (2) abilities, skills, and professional competencies. From this, he developed a survey to measure the factors identified. The survey was administered to a sample of secondary students; the results indicated that an effective teacher is one who practices a more student-centered approach to instruction. The results revealed overwhelmingly that students would like to have teachers who implement instruction that helps them acquire knowledge. Furthermore, the results indicated that an effective teacher is one who has a student-centered approach that involves personal experiences in instruction and takes pride in teacher-student relationships. The researcher shared results with the study participants.

Blotnicky et al. (2015) suggested that adjustments in teacher behavior attributable to a shift in self-efficacy lead to beneficial student outcomes. The researchers analyzed sample teachers' beliefs and knowledge about student's data with attention deficit disorder and the way those contributed to student learning. They found that teachers who felt a personal responsibility for student outcomes, possessed self-efficacy, and wished to help students were more likely to respond that they were more willing to adapt instructional practices in response to student needs. Overall, the study's results showed that teachers who had positive beliefs about students engage in effective classroom practices.

Baumert, Hachfeld, Klusmann, Kunter, Richter and Voss (2013) conducted a multi-dimensional study of teachers' professional competence that included cognitive aspects as the foundation of successful teaching. In the study, teachers' professional beliefs were included as an element of their professional competence to determine their association with instructional practices and student outcomes. The results indicated that teachers with greater professional competence: (1) endorsed a more constructivist view of learning; (2) believed the learner is an active participant; and (3) believed that learning occurs in a social context. The scores of teachers who exhibited the greatest aspects of competency, especially those related to attitude and motivational variables, were related positively to student outcomes and instructional quality.

Campbell, Lee and Longhurst (2017) studied teacher learning in technology PD and its effect on student achievement in science. Their results supported the notion that teacher beliefs are an important factor that can influence instructional decisions. In addition, the researchers reported that teachers' beliefs about knowledge transmission, an indicator of the teacher-centered approach, decreased when teachers participated in the PD. The study indicated that adopting innovative pedagogies that integrate technology requires teachers to change their previously held pedagogical beliefs. The teachers' beliefs improved and the positive effect of teaching technology on student achievement was greater when it was combined with a student-centered, constructionist instructional approach.

Killion (2016) studied teachers learning to use technology and found that relationships existed between teacher practice and beliefs that benefitted students academically. In this study, a school-wide PD was sustained over two to three years and improved the efficacy and effectiveness of instruction as evidenced by increased end-of-grade assessment scores. Six teachers completed four instruments that measured subject-specific self-efficacy beliefs. The results indicated that, at the end of the PD initiative, teachers had significantly greater student-centered beliefs then before their participation.

The review of literature indicated that teacher beliefs and attitudes affect student achievement. This study concluded that further investigation of PD design and implementation processes are needed to support the theoretical framework (teacher participation in PD will change beliefs and teaching practices to improve student achievement). Based on the works of Hur et al. (2015), Kleshman (2016), and Polly et al. (2017), all of whom concluded that teacher beliefs influence student learning, this policy recommendation, which encompasses processes to determine PD participants' beliefs about student learning of mathematics will support the proposed PD design and implementation. Assessment measures similar to the pre and post-test teacher belief survey Polly and colleagues (2017) used could provide data on PD participants' beliefs about, and attitudes toward, their learning and that of their students. The policy recommendation specifies the approach to PD design and implementation informed by the results of the teacher belief survey data to ensure PD participants experience PD that will enhance and change their beliefs about teaching mathematics content positively.

Job-Embedded Professional Development

Finding time for continuous PD must be addressed if teachers are to transform student learning and to achieve learning at high levels, adequate time must be allowed for it. PD that is a part of the teachers' professional responsibilities and activities and a component of the district's and schools' policies will help all stakeholders reach goals to increase student achievement learning outcomes. Job-embedded PD (JEPD) is an approach that can be incorporated into an organization's institutional structure easily and provides teachers with the opportunity to learn in the context of their school environment.

Job-embedded PD that focuses on content is more likely to improve teacher knowledge and subsequent instruction than is specific one-time training. Althauser (2015) investigated the effect of district-wide, job-embedded mathematics PD on elementary teachers' students' state content test scores. According to the author, job-embedded PD conducted in a classroom environment allows teachers to apply instructional practices, that increase the likelihood that they will continue to use the reform-based instructional approach. Furthermore, through a job-embedded approach, teachers can enhance their professional knowledge in core and pedagogical content, and the study of children's acquisition of knowledge. Using the knowledge that they acquire necessitates the needed practice a job-embedded approach affords them.

A variety of methods can support sustained effective PD grounded in instructional reforms. A study conducted on sustained PD's influence on student outcomes in Science, Math, Engineering, and Technology (STEM) measured by a state content standardized assessment demonstrated improved student performance. According to Capraro (2016), the most effective PD is intensive and sustained, and the most positive indicator associated with statistically significant outcomes was teachers experiencing more than fourteen hours of PD in an eight-month period. The results of the three-year study indicated that sustainable PD at the school level that focuses on collaboration among teachers likely will result in improved instructional practice.

Carpraro and Han (2015) investigated whether participating in project-based learning instructional activities influenced math achievement. The teachers in this study participated in sustained PD of STEM project-based learning activities at three different high schools for 30 sessions—seven hours per session over three years. The teachers were required to teach one project-based learning activity in each grading period. All teachers who participated agreed that STEM project-based learning instruction influenced student mathematics achievement and performance positively.

Job-embedded PD is a balance of varied opportunities for learning as an individual professional and with a collective team at the school level. Houchens and Steward (2014) conducted a case study that investigated how job-embedded PD model affected teachers' practice. They examined whether participating teachers experienced growth in their ability to use newly acquired knowledge. The participants volunteered to participate monthly for six months in the JEPD experience, which focused on content, instruction, and assessment practices to enhance instruction to improve student achievement. The results indicated that each participant increased his or her desire to use the new instructional approaches.

An organization that is involved with students becomes empowered to create the best conditions for high levels of learning and student achievement. Job-embedded PD demonstrates a commitment to the culture of learning, and is an ideal approach to enhance students' success. Conner (2015) investigated the relationships in authentic collaboration in five job-embedded PD sessions. Participants collaborated to review student work samples, observed peer teaching and conducted instruction rounds with a focus on improving student learning. At the conclusion of the last job-embedded PD session, participants' perceptions changed from resisting to understanding collaboration. Conner argued that school leaders must afford teachers time to collaborate and learn from one another in a variety of opportunities provided throughout the regular work day.

Job-embedded PD has been shown to be a successful indicator of instructional reform. To help teachers implement effective reform efforts such as changes in curriculum, adjustments in instructional practices, implementation of state standards, and administration of multiple assessment measures, it is necessary for educational institutions to implement on-going, job-embedded PD experiences to improve teaching and student learning. Mazur and Woodland (2015) investigated a campus' implementation of job-embedded PD with their PLC team. A group of high school English Language Arts teachers formed a team and followed the activities of a PLC model with the intent to improve their instructional practices. In implementing the model, the teachers met for an hour and a half weekly and half a day every grading quarter to design interventions to meet all students' learning needs. The results demonstrated that their job-embedded PD experience increased the teachers' ability and skills to examine and use student data more effectively to design interventions.

PD models that adhere to one-time training by outside experts have shown to be less effective. Teachers should view PD experiences as opportunities to learn and apply subject matter and instructional practices that are embedded in their weekly school routines. The National Institute for Excellence in Teaching (2014) published a report on a study conducted in Iowa in which districts offered school-based job-embedded PD. The

Institute worked with the district to integrate collaborative learning teams and instructional coaching models' in the school building supported as their job-embedded PD. Teachers in Iowa embraced the considerable resources available for various forms of job-embedded PD. Because of National Institute for Excellence in Teaching support, the districts in Iowa worked to incorporate collaborative learning teams and instructional coaching as an infrastructure to support the job-embedded PD initiative, and teachers reached a new consensus about the best approach to PD.

Job embedded PD that can increase teachers' instructional skills and students' learning has emerged in educational systems. If a comprehensive framework or infrastructure is in place to support various forms of job-embedded PD, teachers would have opportunities to learn on site, to rehearse and collaborate with peers and to receive individualized supports. Mette et al. (2016) investigated a team of teachers' and principals' perceptions of a three-year effort to provide job-embedded PD. The results indicated an increased awareness of instructional practices and closure of achievement gaps. The job-embedded PD effort included instructional practices in 45-minute pedagogical sessions once each grading period. Teachers' perceptions were measured before and after the experience, and the post-survey results demonstrated a positive effect on their instructional practices.

As teachers continue to perfect their craft and learn to improve curriculum, instruction, and assessment practices, the design of PD programs should provide continuous job-embedded PD experiences. Barnett, Kirby, and Willis (2014) studied the effects of a job-embedded PD program, The System for Student Achievement, on student achievement in 66 schools. The study was designed to respond to research recommendations that improving teaching quality through professional efforts is the best approach to improve student outcomes. The teachers participated in weekly collaborative meetings led by master teachers in which they examined student data, and planned and learned collectively research-proven instructional strategies the master teacher modeled. The master teacher then observed classroom instruction and supported teachers with instructional coaching. The teachers also collaborated with each other consistently to increase their pedagogical content knowledge. The results indicated that the System for Student Achievement PD model had a positive effect on student achievement as measured by higher scores on mandated state content assessments.

Teachers' PD is critical in educational reform efforts, and PD researchers have gathered evidence that the one-time workshop model does very little to transfer PD content to the classroom in a way that affects student achievement. Dimino Gersten, Jayanthi, Newman-Gonchar, Taylor, and the Society for Research on Educational Effectiveness (2013) conducted a study on a teacher study group PD program's effects on student achievement. The teacher study group was the PD approach used to establish teacher networks that created ongoing learning activities for content and instructional approaches for elementary students. The model's goal was to incorporate research-based instructional strategies in their current curriculum. The results demonstrated a positive and significant effect on teacher knowledge and practices and student outcomes.

This literature review provide evidence that PD implementation and design should include job-embedded strategies. Steward and Houchens (2014) found that teachers' instructional skills increased after participating in job-embedded PD as did Gersten et al. (2013). Conner (2015) also reported increased achievement on the part of students whose teachers participated in and job-embedded PD that included collaboration. Woodland and Mazur's (2015) work supported teachers collaborating to analyze data with the specific intent to design instructional interventions. In conclusion, all of the literature presented in this section validated the assumption that teachers who participate in job-embedded PD and apply emerging and innovative PD practices in their classrooms increase their likelihood of continuing to use effective mathematics pedagogical practices.

Instructional Coaching

Instructional coaching is JEPD strategy that serves as a support system to implement new instructional approaches that improve student learning. Instructional coaching is a practice that supports JEPD in the form of on-going specialized instructional assistance that can increase student learning outcomes. According to Lia (2016), using instructional coaches is not a new concept, and is ranked among the most appropriate practices that have been implemented to date. The author conducted a study to assess the effectiveness of using coaching observation checklists to provide teachers with real-time feedback. In the study, teachers from five schools received instructional coaching and traditional PD on implementation of intervention strategies. The study's goal was to determine whether improved instruction through coaching and PD increased student learning. The results showed that teachers' participation in coaching and PD that focused on curriculum, instruction, assessment, and student behavior resulted in improved student outcomes. The author suggested that when teachers receive instructional coaching as well as traditional PD, they learn strategies to make instructional adjustments to improve student outcomes.

Schools' main focus to improve instruction as a result of accountability mandates requires a resurrection of PD that provides teachers with instructional support. Heglund, K. and McKenna (2018), conducted a study on investigating coaching principles and found that a coaching partnership model is a job-embedded PD approach in which a group of coaches works together to serve teachers on an ongoing basis. This study investigated the way coaching partnerships develop inquiry approaches to instruction that lead to changes in teacher practices.

Instructional coaches are individuals who work at the school level to support teachers and incorporate research proven instructional practices effectively through a partnership. As a result of mandates such as Every Student Succeeds Act and NCLB, educational leaders pay close attention to the way both students and teachers learn; and instructional coaching supports learning at all levels for all teachers. Brown (2017) conducted a study that investigated instructional mathematics coaches in four high schools. The coaches' work included ongoing, onsite, job-embedded collaborative planning, data analysis, modeled lessons, and peer observations with feedback. The results showed a significant increase in teachers' implementation of new instructional strategies that they learned with instructional coaching support. Brown concluded that greater use of such models as instructional coaching will allow teachers to relate to, and implement, new learning in their daily work with students.

Instructional coaching can lead to significant transfer of new instructional approaches and an increased frequency of using research-proven instructional practices. Teachers can participate in learning communities in which they receive instructional support from a coach and participate in solving instructional challenges. Kane and Rosenquist (2018) investigated the way instructional coaching improved instruction compared to other forms of PD. The results indicated that using instructional coaches who are held accountable for practicing the principles of coaching, and not asked to perform other duties unrelated to teacher support, is the fastest form of support for teacher learning and changes in instructional implementation.

Ongoing PD located in the context of the professional's daily work environment is an essential aspect of PD. While instructional coaching is not a traditional form of PD and teachers may be unwilling to embrace new ideas, when teachers receive sufficient and meaningful PD, such as that provided with instructional coaching models, they tend to implement programs and practices more effectively that lead to improved student learning. Desimone and Pak (2017) conducted a study on instructional coaching as a high-quality PD in which coaches were a strategy mandated to develop teacher capacity. The results indicated these coaching models are powerful tools that improve teacher knowledge, skills, and practice.

Instructional coaches are used frequently as onsite PD facilitators. Schools and school districts use coaching models to develop and train teachers in data analysis, instructional implementation, and assessment design. Effective job-embedded PD instructional coaches deliver serves to improve teaching and student learning. Johnson

(2016) conducted a study on instructional coaching implementation with consideration of campus administrators. The study provided evidence that coaches have the potential to affect the way teachers teach and students learn through continuous interactions, reflections, dialogue, and analysis as the foundation of problem solving through teaching (Johnson, 2016). According to the author, administrators must have a clear vision of the instructional coach's role and responsibilities to increase student outcomes through improved teacher quality.

Instructional coaching has become the preferred choice to provide onsite, individualized, and sustained PD. Garcia, Jones, Holland, and Mundy (2013) conducted a study on instructional coaching's effects on student achievement at Texas middle schools. The study compared two middle schools in one district, one of which used instructional coaching was used, while the other did not, to determine whether instructional coaching affected student outcomes. According to the authors, teacher instruction was improved and instructional coaching seems to have the greatest effect on building teacher capacity when combined with other forms of PD. The results indicated that teachers in the middle school with an instructional coach changed the way they approached their instructional practices, which led eventually to more positive associations with student outcomes than in the middle school without the coach.

Tenant (2014), conducted a study with English Language Learners' teachers and their instructional coaches and the way the latter's roles influenced their work. The study concluded that coaches influenced the way the teachers taught English by giving guidance on the curriculum, teaching methods, and assessments. The coaches in this study participated in weekly committee meetings to ensure implementation of instructional policies, facilitated annual seminars, and hosted 10-hour workshops for every teacher for nine years. The author indicated that teaching English was more effective as the result of the coaches' guidance.

As school districts focus increasingly on student learning and growth, they are seeking opportunities to develop teachers continuously to improve student outcomes. School districts also are attempting to improve instructional practices in response to a shift in focus to student learning. Instructional coaching is an effective strategy to provide onsite, individualized, and sustained PD as supported by the work of Brown (2017), Johnson (2016) and Kane and Rosequist (2018), among others. The inclusion of job-embedded PD, and specifically an instructional coaching model, in this policy recommendation will provide the district with identifiable changes in teacher classroom practice with the ultimate intent to increase student achievement. The JEPD instructional coaching model is not a new concept (Lia, 2016); however, it does provide on-going specialized support that focuses on the way improved instruction would benefit student learning.

Conclusion

This literature review described the relationships among PD, teacher self-efficacy and student learning. Instructional methods that are student-centered and standards-based require a belief system that supports discovery and connectionist approaches to teaching (Polly et. al, 2013), and such an approach has the potential to lead to increased student achievement. Thus, PD designs must add learning that challenges current belief systems that contradict a student-centered approach. Finally, the literature review included a synthesis of the relationship between job-embedded PD models and student learning outcomes. With the variety of accountability expectations of teachers, job-embedded PD that focuses on content and instruction is more likely to improve classroom instruction and learning outcomes than one-time only district-sponsored PD sessions. According to Althauser (2015), job-embedded PD models also are known to support increased professional self-efficacy and adjust teachers’ belief systems, both of which were correlated with improved student outcomes. This project includes two additional components to the research site’s current PD model: a measure of teacher beliefs before and after participating in PD, and teacher participation in onsite, JEPD models.

Project Description

As a policy recommendation, this project includes continued collection of data on elementary teachers’ participation in PD and its relationship to student achievement on the states’ mathematics assessment. The policy recommendation includes teacher perception data and two PD implementation models in addition to the current content and process district level mathematics sessions: pre- and post-survey data on teachers’ beliefs about teaching mathematics and job-embedded PD models in the form of instructional coaching. In response to enhanced student learning outcomes of elementary mathematics content, the policy recommendation is a one-year PD program for elementary mathematics teachers that will measure the relationship between teacher instructional beliefs and student learning outcomes in elementary mathematics content, participation in district-level PD sessions on math content and pedagogical content, and student learning outcomes of elementary mathematics content, as well as teacher participation in onsite, job-embedded PD led by math instructional coaches and student learning outcomes of elementary mathematics content.

The resources needed for this project are minimal. There will be continued PD design processes that include teacher recommendations, teacher background data analysis, and district administration funding allocation measures to support PD sessions for content and instructional practices designed for the district. For this component of the policy, a committee of stakeholders, including both district and campus curriculum and instructional lead personnel, will meet over the course of two to three months to analyze data and begin designing the district-led PD sessions. This committee will then present the year-long plan to another set of constituents: school principals with whom the committee will share their data analysis and recommendations for the district PD program. The principals then will take the proposal back to their individual campuses for feedback. During the next month, all principals will return as a collective team and share feedback with the district PD committee to adjust the design if necessary. The district committee then will finalize the one-year PD plan for the upcoming school year beginning in August and ending in March to include monthly content sessions and quarterly instructional (process) sessions. The formation of the district and campus curriculum and instructional committee’s work for data analysis and preliminary planning will take place in January and February, and the district PD will be designed from February to May. The school principals will receive the first presentation of the preliminary plan in an hour-long presentation in March, after which they will take the tentative plan to their individual campuses for feedback throughout the month of March during collaborative campus team meetings and/or campus faculty meetings. In April, the campus principals, as small teams, will present their feedback to the district team. The district PD committee then will deliberate on the feedback during April and in May, and will present the final plan to the principals with feedback and adjustments.

From May through July, each principal will take the district PD program plan and work with his/her campus to create a campus-based, job-embedded PD plan. The principals will submit their individual plans to the district PD department in August. The campus PD plan will include belief survey data collection twice a year, first in August and then in May, and every teacher will commit to district-led PD sessions held monthly and quarterly, and participation in weekly job-embedded PD in the form of an instructional coaching partnership model. Every school principal will review the district and campus PD plans beginning in August or as new staff members are hired.

The Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) developed by Enochs et al. (2000) will serve to evaluate mathematics teaching efficacy. Data will be collected from all mathematics teachers before the first month of formal instruction begins and during the last month of instruction in each new school year and then analyzed. The results from the MTEBI will be used to establish job-embedded PD goals to increase mathematics teaching efficacy and concomitant student outcomes. The instrument will elicit information about the way teachers feel about their practices in teaching math content, and based on the pre-and post-instrument results, the onsite instructional leaders (principal and instructional coach) will define the focus for the job-embedded PD tasks, including but not limited to training, instructional observations with feedback, and development of instructional strategies with lessons the onsite instructional coach models.

The school principal and instructional coach will spend time before the beginning of the school year reviewing the teachers' professional background in education and the MTEBI results to design a targeted plan of instructional coaching support. The priorities will be those teachers in need of improving instruction and those with no previous experience. Based on the MTEBI pre-instrument analysis and teacher demographic data, the major models of the PD from the instructional coach could include planning standards-based math lessons, modeling math instructional practices, and mentoring. Furthermore, the instructional coach will conduct monthly observations and provide instructional feedback to improve practices of teachers involved in an instructional coaching cycle. The resources needed for this element of the project include the MTEBI instrument, instructional coaching implementation resources, and an instructional coaching feedback form. Lastly, the instructional coach will participate in bi-weekly collaborative coaching meetings with the principal to review instructional feedback and determine the next steps to support teachers participating in the onsite instructional coaching cycle.

Informing the results of PD initiatives is guided through an evaluation process. This project's policy recommendation to explore and implement additional PD methods to improve student outcomes will measure students' progress and inform the school's improvement practices. The type of evaluation planned for the project result is outcome-based. Student outcomes will be an element of the evaluation plan and will be measured by the state assessment for mathematics with the goal to increase scores. Teacher scores on the MTEBI survey before and after their onsite, JEPD experiences will be included as well.

Evaluation Justification

The selection of an outcomes-based evaluation plan for the project is grounded in the fact that the project has established goals for the PD programming to improve student learning outcomes in elementary mathematics. Data analyzed to evaluate this project will inform teacher learning and training needs to change their instructional practices with the ultimate goal of improving student achievement. In addition, an outcomes-based evaluation includes opportunities for onsite reform initiatives based on the MTEBI and student learning measured by STAAR for students whose teachers participate in recommended onsite, job-embedded instructional coaching methods. The outcomes evaluation method will include both short- and long-term objectives. The short-term objective will focus on outcomes of teacher beliefs and instructional approaches, while long-term objectives will focus on improvements in student achievement. Lastly, an outcomes-based evaluation plan will serve as a measure of the way continuous improvement of teachers' PD is related to schoolwide accountability and results.

Evaluation Goals

The evaluation of the policy recommendation will include goals to improve student outcomes that measure each element of the project. One component that will be evaluated is the results of the MTEBI pre- and post-scores. The MTEBI contains a

Mathematics Teaching Outcome Expectancy and a Personal Mathematics Teaching Efficacy subscale, in which each item is measured on a 5-point Likert scale (see Appendix B). This component's goal is to increase efficacy in teaching mathematics. Evidence that the goals are met will be evaluated by the selection of positive items on the MTEBI and measures of the pre- vs. post-answers to each statement. The goal to increase mathematics teaching efficacy is an element of the evaluation goal to increase the likelihood of continued use of reform-based instructional practices.

The second element of the project that will be evaluated is student outcomes, which relate to student achievement. Typically, student outcomes describe the mathematical knowledge, abilities, or specific skills the student is expected to acquire. This evaluation plan, the goal of which is to improve student learning outcomes, will use the STAAR to assess learning mathematics concepts. Evidence will be gathered from the state accountability report for student performance in mathematics which is distributed to each school upon the conclusion of the school year. Each school will use the reports to analyze student scores and determine the mean improvement for those students whose teachers participated in the recommended onsite, job-embedded PD methods, such as instructional coaching cycles. Overall, the goals include increasing student outcomes in mathematics by increasing positive responses on the teacher beliefs instrument to increase implementation of reform-based instructional practices acquired through job-embedded PD methods.

Evaluating this project as a policy recommendation is designed to provide reliable and meaningful results for all stakeholders involved in implementing the policy. To do so, the goals intended are clarified with an assessment of those included. The key stakeholders include the school board, district superintendent, district and campus administrators, teachers and teacher teams, and instructional coaches.

Project Implications

Local Community Implications

Research and this study have provided evidence that teacher quality is related to student learning outcomes. The results of this study and the subsequent policy recommendation project will contribute to positive social changes that affect educational leaders, teachers, and students. Both district and onsite PD methods are the most critical factors in strengthening teacher quality and improving student learning outcomes. The purpose of this study was to determine whether there was a relationship between teacher participation in district PD and elementary student mathematics achievement. Based on the results, additional variables will be measured in the project to develop a policy recommendation that includes teacher beliefs about teaching and learning mathematics and teacher participation in both district and onsite, job-embedded PD methods, specifically instructional coaching partnerships. Based on the results of teacher efficacy MTEBI data, teacher participation in PD has been shown to increase positive attitudes about teaching and learning mathematics and increased adjustments to instructional approaches that support positive social change at the local level.

The first implication of positive social change includes the research site's leadership team. This team has established protocols to analyze current PD design and implementation practices that include analysis of student learning outcomes, and found that without the proposed policy recommendation, current practices had little to no relationship to student outcomes on the state mathematics test. The research site will include analysis of the results of the teacher belief tool during the proposed design stages of the PD. The positive social outcome implication will increase the likelihood of designing PD methods that address the results of teacher beliefs and teacher background data to improve PD implementation practices.

The next implication for positive social change is the teachers' participation in PD methods. Elementary teachers now will participate in both district-led and onsite JEPD designed to meet their individual instructional needs. The district-led PD will continue to offer both content and process sessions and add opportunities for teachers to expand their new inquiry and learning during their daily work experiences through onsite JEPD methods, such as collective team planning and instructional coaching partnerships. Through such methods, the teachers will have opportunities to practice and refine their newly acquired instructional approaches to improve instructional quality and student learning outcomes in mathematics.

The last implication for positive social change affects the students of the teachers who participate in implementing the new policy recommendation. The goal for this entire study was to determine the strength of the relationship between teacher acquisition of new instructional practices and student learning outcomes. District scores indicate that students need to increase their learning outcomes on several mathematical concepts, including Numbers, Operations, and Algebraic Reasoning. Based on the results of this study, there were minimal gains in student outcomes on these concepts as measured by the state math assessment for those students with teachers who participated in the current district-led PDs.

Larger Community Implications

Teachers' effective instructional practices influences student learning outcomes greatly. Schools and school districts are taking advantage of PD programs to improve teacher instruction. As measures of accountability become entrenched into the educational system, the need for effective PD become paramount (Guskey, 2017).

When measurements of teacher beliefs were included and reviewed to inform PD design and implementation to improve teaching quality and student learning outcomes in the U.S., teachers all over the country were more apt to change to more effective instructional approaches when they engaged in PD methods that influenced their beliefs about teaching (Polly et al. 2017). Teachers who implement effective practices after participating in well-designed and research-based PD are prepared better to meet their students' ever-changing needs. The implications for implementation of effective PD practices are great for school districts around the country. Accountability measures such as Every Student Succeeds Act and NCLB, requires districts to collect data on student achievement and highly qualified teachers. The use of these and other data can inform the design and implementation of effective PD practices. Districts, including the research site for this study, have district PD departments and/or developers who analyze data to determine the most effective PD strategies. By including teachers' beliefs about teaching and learning mathematics data in the data analysis process, those responsible for designing the school's or district's PD can incorporate, teacher instructional practices that are more likely to be consistent with student-centered approaches to teaching. The literature supports PD developed to increase teacher effectiveness with the ultimate goal to increase student achievement.

This project is based on the assumption that teachers want to become more effective to improve their students' learning outcomes. As increased accountability measures now lead the development of district instructional policies, teachers are seeking specialized supports to help them improve their instructional practices to improve student learning outcomes and PD methods can support teachers' instructional needs in a variety of ways. The social influence of such effective PD methods as sustained, job-embedded methods of PD consistent with the organization's mission and goals to improve student learning is one such positive outcome.

Section 4: Reflections and Conclusions

Project Strengths and Limitations

This project responded to teachers' and school leadership's demand for PD that results in improved instruction and increased student achievement. Because of increased accountability for student learning, teachers now demand opportunities for professional growth in research-based, up-to-date content and instructional processes. These professional growth opportunities can be delivered through effective PD design and implementation. Thus, this policy recommendation project encompasses opportunities for PD designs to meet teacher needs as identified using data on their background and beliefs about student learning. In addition to strengthening teachers' instructional capacity through methods like district PD sessions on math content and instructional practices, this policy recommendation also includes PD implementation support from sustained, job-embedded PD methods such as onsite instructional coaching partnerships. The strengths of this project are that it can produce a policy recommendation that addresses PD design processes by including the collection and analysis of teacher belief data and PD T-TESS implementation processes data.

Despite the project's strengths, there are also limitations. The policy recommendation includes research and approaches to address improvements in PD design and implementation based on the results of a correlational study that revealed no relationship between teacher PD participation and student outcomes on the state assessment in mathematics during the 2015-16 school year. Because none of the hypotheses were supported, changes in the design and implementation of PD are necessary to ensure these processes are consistent with the teachers' needs so they can best serve their students. The policies for other PD designs and implementation practices may already include collecting teacher belief data to refine the designs further and/or encompass onsite implementation strategies and still yield no significant relationships between student outcomes and teacher PD. Because this project's policy recommendation specifies only the MTEBI teacher belief instrument, further investigation may be needed to determine whether another teacher belief instrument would capture the teachers' needs best to develop the most effective PD. Further, the sustained, job-embedded onsite approach to PD implementation might not be the most appropriate method to implement. However, the literature has many other PD methods that could create onsite opportunities for teachers to strengthen their content knowledge and instructional approaches.

Recommendations for Alternative Approaches

Based on the results of this study, teachers' attendance at district-sponsored PD sessions had little influence on student performance on the state mathematics assessment during the 2015-16 school year. Thus, the project's policy recommendation will add two other PD methods to the district's current PD policy to measure teachers' teaching beliefs, and the effectiveness of sustained, embedded onsite PD methods such as instructional coaching partnerships. However, an alternative approach to address the district's poor student performance on the state mathematics assessment may necessitate a different type of onsite job-embedded PD method such as collaborative teaming.

Collaborative teaming is a PD method rooted in PLCs. A PLC is an effective job-embedded PD method that increases teacher collaboration to evaluate student performance. This alternative approach affords teachers an opportunity to work once a week as a grade-level team to select essential learning targets, formative assessment methods, and data analysis procedures to implement that are consistent with state mathematics standards. The research site could implement collaborative teams during the second week of school and ending the last week. With district support, the school leader would create a master schedule that allows at least 90 minutes for each collaborative team to design essential learning standards and assessment tools and practices based on state standards and student assessment results.

Additionally, misinterpretation of student scores on formative mathematics assessments may have contributed to the fact that students' results on the state assessment were unrelated to their teachers' PD experiences in improving mathematics instruction. During the study, formative assessment practices were implemented several times during the academic year, and the data were used to measure student proficiency. However, it was unclear whether teachers used these results to adjust their instructional approaches or whether they adjusted based on the results of the math assessment outcomes. As the PD policy did not include job-embedded PD practices such as an instructional coach, teachers did not have the assistance needed to analyze formative assessment data with which to modify their instructional approaches. Analysis of such data and parallel changes in teacher instructional approaches combined with job-embedded PD methods may help teachers determine gaps in mathematical proficiency more accurately.

Scholarship, Project Development and Evaluation, and Leadership and Change

The processes involved in the development of this study of the relationship between student achievement and teachers' PD provided clarification for many stakeholders. State, regional, and district leadership can understand the reality of student performance trends in mathematics and the way teachers' beliefs about teaching and learning mathematics relate to student learning. Second, the results of the study provide leaders with information with which to evaluate the significance of the effect of teacher PD on student mathematics learning outcomes. The project results revealed the dismal reality of student learning in one district, in addition to a response to poor student learning outcomes in mathematics in the form of teacher instructional improvement methods through PD models. The processes involved analyzing the data that assessed the strength of relationship between a group of third grade teachers who participated in mathematics PD and their student's learning outcomes as measured by their performance on the state mathematics test. Finally, the processes involved in developing the policy recommendation project were a response to the study results. It is necessary to assess teacher beliefs about teaching and learning effectively and to implement JEPD to change teacher instructional practices and increase student achievement.

Personal learning and growth as a scholar practitioner and project developer occurred throughout the research process. Through this process, I learned essential skills related to defining a problem, designing a study, and analyzing results from which to draw conclusions accurately. Second, I learned the importance of the credibility of the results with which to develop a policy recommendation for my district. Finally, I learned the importance of scholarship and leadership in sharing ideas, recommendations, and suggested practices with educational leaders and policy and decision makers. As a scholar practitioner practicing in the field currently, I described the current realities of elementary students' learning in mathematics content in my district. As an elementary teacher, I have experienced firsthand the reality of students struggling to learn mathematical concepts. I often sought out experts in the field for solutions, but did not seek clarification about why the issue occurred. Through this research, I acquired the tools to define the issue and seek solutions to resolve it.

Reflection on Importance of the Work

Student achievement in mathematics is a high priority, as the increased implementation of STEM programs throughout the country to meet workplace demands demonstrates. Students' mathematics performance must be measured and remedied to ensure high levels of learning through a variety of integrated, real-world experiences as a foundation to become better prepared for the work force. Mathematics is used, applied, and seen everywhere, and students must engage in its exploration so they are comfortable when they need to apply its concepts to solve real-world problems. The work completed throughout the project's development provided clarity and tangible solutions to improve student learning outcomes in mathematics by identifying the reality of that learning and a solution to address the issue by improving instructional quality through appropriate and effective PD.

Implications, Applications, and Directions for Future Research

Continued analysis to determine the relationship between teacher beliefs about teaching and learning mathematics, teacher participation in PD, teacher instruction, and student mathematics achievement has the potential to effect positive social change. The development of a comprehensive PD program emerged from this study that could affect school reform efforts positively by providing PD opportunities that meet teachers' needs and increase student achievement. Understanding what teachers believe about teaching and learning elementary mathematics helps PD designers and implementers provide teachers with in-depth PD experiences. Individual teachers who engage in continuous job-embedded and district-led content and process PD methods will have a positive influence on their students' math learning outcomes and engaging families while teachers modify their instructional approaches will increase parents' confidence in teachers and schools' work. Finally, organizational leaders and policy makers will begin to recognize their need to support the change in instructional practices that affect student learning outcomes directly, as well the necessity to validate teachers' beliefs and needs that drive their PD.

This study's methodology focused on determining the direction and strength of the relationship between student achievement, instruction, and PD using a quantitative correlational design. However, the results revealed no significant relationships among the variables. As the null hypothesis was not rejected, an ad hoc power analysis, Creswell's (2014) *G*Power 3.1: Tests for correlation analyses* (Table 7), was conducted to gauge the effectiveness of the hypothesis test and to minimize the probability of failing to detect a

Type II error. The value of the power was computed using a significance level of 0.05 to ensure a power of 0.95. The power results indicated for an exact power calculation of 0.99 I needed a sample size of N = 34 teachers. This is higher than the requested power of 0.95. According to Triola (2012), a power of at least 0.80 is a common requirement for determining the hypothesis test is effective and can be used to determine the minimum required sample size (Triola, 2012).

The study's theoretical implications centered on Guskey's Model of Teacher Change (2017), which suggests that the three major outcomes of PD includes teachers (1) making changes in their classroom practices; (2) perceiving evidence of improvements in student learning, and (3) changing their attitudes because they see how much better their students are learning. Future research designed to assess the relationships among PD, student achievement, and instruction could have different implications, as this study did not measure teacher beliefs and attitudes. However, studies on PD and student achievement that support theoretical frameworks such as Guskey's model by measuring all three variables (PD, student achievement, and teacher attitudes and beliefs have demonstrated statistically significant relationships.

Including data on teacher beliefs about teaching and learning elementary mathematics in the statistical analysis is recommended in future research. The project's policy recommendation suggests that designing and implementing PD methods that have the greatest effects on student learning outcomes should include PD that addresses teachers' belief systems. A change process to include data on teacher participation in both district-led sessions and job-embedded programs in the analysis is another recommendation for future work. The change processes identified in this study on professional learning, instruction, and student achievement in elementary mathematics are methods to sustain positive effects in educational improvement efforts for future practices.

Conclusion

Student achievement in elementary mathematics continues to be a troubling issue in schools today, and comprehensive PD in mathematical content for elementary teachers has not been at the forefront of school reform efforts. Student learning outcomes in mathematics on state assessments could increase if teachers are prepared well. Based on the limited results of this study, teachers who engage in continuous PD and meets the demands to strengthen both math content and pedagogical knowledge will yield greater outcomes in student learning. Professional learning opportunities and practices must provide the support for elementary teachers of mathematical content to grow and change their practices to improve student learning outcomes. This study has provided evidence that for teachers to improve their instructional practices to increase student achievement in elementary mathematics, they must engage in continuous professional growth to become learner- and learning-centered through high-quality PD programs.

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Appendix A: The Project

Policy Recommendation White Paper

Professional Development Design, Implementation, and Student Outcomes

Table of Contents

Introduction

School districts use professional development (PD) practices to enhance the quality of teacher performance as a support mechanism to improve student outcomes. However, educators believe that PD has little effect on their daily instructional responsibilities and student outcomes (Guskey, 2017). This policy recommendation stems from a quantitative correlational study that investigated the relationship of student math performance and evidence of math instructional practices of a group of elementary teachers who participated in a district-led math PD program. Furthermore, this policy recommendation is intended for school districts who wish to revise their PD design and implementation practices to achieve sustained improvement in teacher instruction and concomitant student outcomes.

Problem

According to Guskey (2017), some educators find PD as a waste of time because of poor planning and implementation. Many participate in PD opportunities as a result of professional responsibilities set forth through their annual evaluation processes. Furthermore, Guskey purported that, despite educator’s beliefs about PD, it is seen as something to get out of the way. However, evidence shows that PD programs can be highly effective when teachers believe they are effective, and designed and well supported.

Accordingly, I conducted a study on PD and student achievement in elementary mathematics, calculated the correlation between implementation of math instructional strategies measured by T-TESS implementation scores (school district’s teacher evaluation tool), dosage of math PD hours received, and student outcomes as measured by the Texas state math assessment. The goal of the study was to investigate whether teachers' participation in district-led PD and the implementation of strategies learned in those programs improved teachers' math instruction and student outcomes on the state math assessment.

The results of the study demonstrated an insignificant relationship between student outcomes on the Texas state math assessment and T-TESS scores and teachers' participation in district-led PD. Because the null hypotheses were not rejected, the results failed to confirm the hypothesis that teachers' PD experiences effect changes in their instructional approaches. However, the results revealed aspects of the district's current PD program that inhibit its effectiveness, specifically implementation of the district-led PD. Guskey (2017) suggested that after experiencing PD, educators who do not exhibit change in their instructional practices, beliefs, and their students' achievement may not do so because they did not perceive that the PD had a clear purpose. Similarly, he asserted that when educators understand why they are engaging in PD, the experience tends to be more effective for them and stated further that when PD has no clear intent, providers may neglect to implement a valid and useful evaluation process. The policy recommendation proposed herein will provide the district with a research-based method to strengthen its PD design, implementation, and evaluation.

Rationale

Based on the results of this study, recommendations for changes in the district's design, implementation, and evaluation of PD are encouraged strongly. According to

Brussow, Gaumer, Noonan, and Supon (2017), effective PD emerges from teachers expressed needs with a direct connection established between those needs and the students' achievement levels. This study did not investigate participants' beliefs and attitudes with respect to the PD they attended. Thus, this policy recommendation will include processes to measure teachers' self-efficacy before and after their PD experience. Lastly, the recommendation will provide district personnel who evaluate teachers' instructional approaches before and after teachers participate in PD with resources to strengthen the process used to measure implementation of instructional practices.

Research Questions

Research Question 1: What is the direction and strength of the relationship between the number of math content PD courses attended and student achievement scores on STAAR?

To address this question, the number of content PD courses attended was correlated with the dependent variable, student achievement scores on STAAR and a bi-variate correlation was used to analyze the relationship. The correlation coefficient, *r*, was -0.14, indicating that there was only a weak negative relationship between the number of content PD sessions teachers attended and student outcome scores, as the number of PD courses teachers attended predicted less than 1% of student outcome scores. Thus, the null hypothesis was not rejected at $p < 0.01$.

Research Question 2: What is the direction and strength of the relationship between the number of math process PD courses attended and student achievement scores measured by STAAR?

To answer this question, the number of process PD courses attended was correlated with the dependent variable of student achievement scores on STAAR using a bi-variate correlation to describe the relationship. The correlation coefficient was 0.11, indicating that there was a weak positive relationship between the number of process PD sessions attended and student scores, as the number of courses attended predicted less than 1% of student outcomes scores. Therefore, the null hypothesis was not rejected at $p < 0.01$.

Research Question 3: What is the direction and strength of the relationship between the number of math content PD courses attended and T-TESS scores?

To address this question, the number of math content PD courses attended was correlated with T-TESS implementation scores using a bi-variate correlation to describe the association. The correlation coefficient was -0.04, indicating that there was a weak negative relationship between the number of content PD sessions attended and their T-TESS implementation scores, as the number of sessions teachers attended predicted almost none of student outcomes scores. Thus, the null hypothesis was not rejected at $p < 0.01$.

Research Question 4: What is the direction and strength of the relationship between the number of math process PD courses attended and T-TESS scores?

To answer this question, the number of math process PD courses attended was correlated with T-TESS implementation scores using a bi-variate correlation to assess the relationship. The correlation coefficient was 0.17, indicating there was only a weak positive relationship between the number of PD sessions teachers attended and their T-

TESS implementation scores, as they predicted less than 1% of student outcomes scores. Accordingly, the null hypothesis was not rejected at $p < 0.01$.

Research Question 5: What is the direction and strength of the relationship between T-TESS scores and student achievement scores on STAAR?

To address this question, T-TESS implementation scores were correlated with student achievement on STAAR and a bi-variate correlation was used to describe the relationship between the variables. The correlation coefficient was 0.19, indicating that T-TESS implementation scores predicted less than 1% of student achievement. Therefore, the null hypothesis was not rejected at $p < 0.01$.

Evidence from the Literature

A well-designed PD model can yield increased levels of teacher implementation of knowledge and skills learned and concomitant increased student achievement (Knipe & Speck, 2005). Such a PD program has a clear focus, on improved student learning. The literature review provides evidence that supports the proposed recommendation to redesign the district's PD program.

Components of Effective Professional Development Design and Implementation

Elements of effective professional organized into several components. Components of effective PD include teacher beliefs about student-centered instruction, job-embedded professional development, and instructional coaching. There is a description of three components of effective PD design and implementation detailed in this section; teacher beliefs, job-embedded professional development, and instructional coaching.

Teacher Beliefs

Processes that measure teachers' self-efficacy before and after PD participation strengthen PD design and implementation. (Alhaser, 2015). Changing teachers' beliefs about learning is considered critical to changing their classroom instruction. Guskey's model (2017) demonstrates the importance of staff development working to respond to teachers' beliefs to effect changes in their instructional practices. Teachers' beliefs about what makes an effective mathematics teacher have been associated with instructional decisions, and relationships between changes in teachers' beliefs and their teaching practices influences Guskey's model strongly.

Key components of teacher beliefs. Research has identified three distinct aspects of a teacher's beliefs system about teaching mathematics (Polly et al., 2013).

- A teacher who teaches mathematics believes that math is a set of facts presented with teacher-centered methodologies;
- Instead, a discovery mathematics teacher believes math includes knowledge that is learned best through student exploration, and
- A connectionist mathematics teacher relies heavily on experiences and real-life connections to help students learn math concepts.

Job-Embedded Professional Development

Inherent in the definition of any PD program is continuous professional learning that must be implemented for teachers to transform student learning. However, to achieve the highest levels of student learning, adequate time must be allowed for teachers to participate in meaningful job-embedded professional development. Job-embedded PD which is an integral component of the teachers' professional instructional practices and the district's and schools' policies, helps teachers reach their goals to improve student achievement outcomes and increase student learning. Job-embedded professional development is an approach to an institution's structure that provides teachers the opportunity to learn in the context of their school environment.

Key components of job-embedded professional development. Job-embedded professional development that focuses on content is more likely to improve teacher knowledge and instruction than is specific one-time training. Althauser (2015) investigated the effect of district-wide, job-embedded mathematics PD and elementary student scores on a state assessment. According to the author, job-embedded professional development conducted in a classroom environment allows teachers to:

- Apply instructional practices, which, increases the likelihood that the teacher will continue to use the reform-based instructional approach;
- Enhance their professional knowledge in core and pedagogical content, the study of children's acquisition of knowledge, and
- Use the knowledge they have acquired by practicing what they learn through job-embedded professional development.

JEPD is a balance of varied opportunities for teachers to learn both individually aa a collective team learning at the school level. To help teachers implement such effective reform efforts it is necessary for school districts to implement on-going, JEPD opportunities for teachers to help improve their instructional practices and concomitant student outcomes. PD models that entail one-time training by outside experts have been shown to be less effective. Teachers should view PD experiences as opportunities to learn and apply what they learn directly to their instruction.

JEPD that can increase teachers' instructional skills and students' learning has emerged in educational systems. Comprehensive frameworks and infrastructures that support various forms of job-embedded PD provide teachers with opportunities to learn on-site collaborate with peers. As teachers continue to perfect their craft by improving their curriculum, instruction, and assessment practices, the design should provide them with continuous professional growth experiences to support their learning.

Instructional Coaching

Instructional coaching is a component JEPD school districts use to provide individualized instructional support for teachers. This form of JEPD provides teachers with a support system to implement instructional strategies with the intended result to improve student outcomes. Instructional coaching is a practice that supports job-embedded PD through the use of on-going specialized instructional support to enhance student learning outcomes.

Key components of instructional coaching. Essential aspects of JEPD are that it is ongoing and conducted in the context of the professional's daily work environment. Instructional coaching is not a traditional form of PD and teachers often are unwilling to embrace new ideas (Brown, Browning & Harrell, 2017). However, when teachers receive an ample amount of PD, such as that instructional coaching models provide, they tend to implement programs and practices more effectively that enhance student learning. Instructional coaching can lead to the significant transfer of new research-proven instructional approaches and an increased frequency with which they are used (Brown, Browning & Harrell, 2017). There are two types of instructional coaching: group and individualized.

Teachers can participate in learning communities in which they receive instructional support from a coach (individualized coaching) and collaborate with peers (group coaching) to solve instructional challenges. Instructional coaches are used frequently as onsite PD facilitators and many states use instructional coaching models to develop and train teachers in assessment design, data analysis, and instructional implementation. Job-embedded PD from effective instructional coaches serves to improve teaching and student learning (Desimone & Pak, 2017).

As school districts focus increasingly on student learning and achievement, they are looking continuously for opportunities to develop teachers with the ultimate goal to increase student achievement. Instructional coaching uses relationships between staff members to create conversations that could lead to instructional change. State education leaders also are seeking to improve instructional practices through instructional coaching models in response to a shift in focus to students learning and growth.

Research Design

According to the Education Trust (2016, p.7), schools must "…stop guessing and start using research" to improve student performance. TXSD leaders examine student achievement data to inform the PD they provide, and maintain quantitative data about the number of courses offered and number of attendees at each PD session or opportunity. This quantitative study documented the direction and strength of the relationship between the number of PD sessions attended, implementation, and student achievement. The number of math content and process PD session attended was measured through session attendance reports to calculate each participant's total number of sessions. Teachers' T-TESS scores from district observations served as the proxy for implementation.

To answer the research questions, a correlational design was employed to investigate whether relationships exists among the variables investigated (number of content and process courses attended (dosage), T-TESS implementation scores, and student achievement). A bivariate correlation determines whether and the way in which two continuous variables are related (Creswell, 2014). However, it does not permit attributions of causality. The strength and directions of the relationships between the number of PD courses attended, T-TESS implementation scores, and student performance on the STAAR for mathematics were reported as correlation coefficients. Scores from this analysis fall along the correlation coefficient's line of best fit from -1.00 to 1.00, with 0 indicating no relationship. A bivariate correlational design was employed to investigate the research questions. The research problem required investigating the direction and degree of association between four different sets of variables: the number of math content PD sessions teachers attended (dosage); the number of math process sessions attended (dosage); T-TESS implementation scores, and math achievement scores. The number of PD sessions was measured on a ratio scale, while the implementation scores and student STAAR scores were measured on an interval scale. During observations, teachers obtained an average performance rating for each observation in each of the four domains: planning; instruction; learning environment, and professional practices and responsibilities. Performance in each domain was rated on a five-point Likert scale, the mean was computed and then a single rating was assigned.

Data Collection and Results

Data collection occurred at the research site. A meeting was held with the district's Executive Director of Accountability requesting access to the district's student performance scores raw data, teacher PD attendance (dosage), and instructional T-TESS implementation scores that were obtained subsequently from the district's Research and Accountability Department's data management system. The Director of Research agreed to generate a data file for the datasets requested.

Data Analysis Results

The Pearson Product Moment correlation, *r*, was used to measure the strength of the linear association between: (1) the number of math content PD third grade teachers attended and student scores; (2) the number of math process PD attended and student scores; (3) the number of math content PD courses attended and T-TESS scores; (4) the number of math process PD courses attended and T-TESS implementation scores, and (5) T-TESS implementation scores and student achievement scores measured by STAAR. After the correlations were calculated between each pair of variables, the strength of the association between each was determined. The null hypothesis was not rejected any of the pairs of variables analyzed, indicating that, there was no relationship between the independent and dependent variable for each of the pairs. In this study, the R^2 expressed the magnitude of the association between the variables as the effect size, which is another way to assess the relationships' magnitude (Creswell, 2014).

Discussion of Findings

The strength and direction of correlations for each pair of variables were analyzed based on the theoretical framework of Guskey's Model of Teacher Change. The model highlights three major outcomes of PD including: teachers change their classroom practices; perceive evidence of improved student learning and change their attitudes accordingly. Overall, none of the five research questions' null hypotheses were not rejected; all correlations among the pairs of variables were significantly weak. The results of this correlational study determined non-significant association between the variables, indicating that teachers in the study did not change their practice, achieve evidence of improved student outcomes, and change their beliefs as a result. As a consequence, the results of this study may inform the district's current t practices in the design and implementation of elementary mathematics PD more effectively, and help its professional developers identify effective strategies to support teacher learning during PD experiences. This study assumed that various types of educational training in elementary mathematics instruction influenced teachers' ability to increase student achievement but the results did not support the assumptions.

The study had certain limitations. First, researchers assert that the size of the correlation generally is unstable in small samples. For example, Perugini and Schonbrodt (2013) indicated that a sample size of 250 persons is necessary for stable estimates. As the sample size in this study was less than 40 participants, one can assume that a correlation would demonstrate a relationship regardless of the sample size. However, this was not the case. A second potential limitation of the study may have been general in nature, such as inadequate measures of the quality of teacher training that would make it difficult to generalize the findings to other teachers or situations. There also may have been a number of implicit assumptions underlying student achievement in addition to teachers' participation in PD, such as influences from lack of family support with education endeavors or poor achievement in prior schooling experiences. Finally, the scope of this study was limited to one grade level, included data collection only on teachers' attendance in district-led, face-to-face math PD sessions for one school year, and state elementary mathematics student achievement assessment data from that same year. The parameters did not include data from attendance at any other PD.

Policy Recommendation

The purpose of this white paper and concomitant policy recommendation is to provide my school district with a recommendation for the design and implementation of both district-developed PD and school-based JEPD. The recommendation includes an analysis and evaluation of the district's current PD design and implementation based on the study results. Changes in teaching practices, most importantly those that embody classroom discourse and effective curriculum implementation, occur as teachers develop beliefs consistent with student-centered instructional practices. The policy recommendation is intended to be implemented in three phases. The purpose of the phased approach is to provide the district with the opportunity to evaluate each phase's effectiveness and make changes if needed.

Phase One will include a timeline to design the district-led PD program. Phase Two will focus on the design of the new job-embedded professional development (JEPD) program, which encompasses three components: [collaborative learning, on-site content training, and lesson planning]. Phase Three will implement the individualized instructional coaching component of the JEPD model at every school in the district. All phases will occur during a one-year PD for every elementary teacher in the district.

The resources needed for this policy recommendation, are minimal. Each school will need access to the teacher belief survey and requisite time to administer and analyze the results. All other resources such as the time allocated for ongoing, site-based JEPD methods are embedded already in each schools' master schedule; each elementary school in the district is allocated an instructional coach for mathematics.

Policy Recommendation: Phase 1

Phase One encompasses the redesign of the district-led PD processes and includes: establishing a district PD committee; soliciting PD recommendations from schools, analyzing the district's staff demographic data (teaching background and years of teaching experience) and student performance data, and reviewing its PD budget. The district PD committee is an established committee that includes district curriculum and instruction lead personnel and campus instructional coaches. The district PD committee will meet over the course of two months to complete the district-led PD redesign processes. Upon completion, the committee will present their proposed district PD plan to every school principal. Each principal will then take the plan back to his or her campuses to elicit initial feedback from instructional staff. In March, all principals will meet with the district PD committee to share feedback their instructional staff provided. In April, the committee will review and consider the schools' feedback and use this information to finalize the PD plan. In May, the committee will present the final PD plan to all school principals. Implementation of the PD program will begin in August and end in March of the upcoming school year.

Table 1

Timeline Policy Recommendation-Phase 1

Month	Activity	Participants
January – February	Data Analysis/Pre-liminary District PD planning	District PD Committee
February – March	Development of PD Design Proposal	District PD Committee
March	Campus Feedback on PD Design Proposal	School principals and District PD Committee
April	Principals share campus feedback on proposed PD Design. District PD Committee deliberates on feedback.	School principals and District PD Committee
May	Presentation of final PD plan.	School principals and District PD Committee

Policy Recommendation: Phase 2

Each campuses' JEPD plan will be designed in Phase Two. Every campus will implement three JEPD components: team learning design collaboratives with the instructional coach, team content planning with the instructional coach, and on-site math content training on the part of the onsite instructional coach. Phase Three will include additional tasks of the instructional coach. From May through July, each principal will collaborate with his or her instructional leadership team to create a campus-based, JEPD plan. Every school principal will review the JEPD plan with his or her staff at the beginning of the academic year (August) and with all new staff members who are employed throughout the school year. The MTEBI will be administered to evaluate the teaching staff's mathematics teaching efficacy, and the data will be collected from all mathematics teachers at each school one month before the beginning and during the last month of the instructional school year.

JEPD Component 1: Team learning design collaboration. One of the three components of the JEPD plan will be team learning design collaboration. Each grade level at every school will meet once weekly as an entire grade level team with the campus math instructional coach to design math instructional units. The learning design process will include weekly 90-minute collaboration time (time allocated currently in each school's master schedule) in which every grade level team will deconstruct the state standards in each unit (identify the expectations of learning as mentioned in the state math standard), identify essential academic vocabulary for each unit, select a goal for student mastery for each unit, develop a common assessment to measure that goal and develop daily learning objectives. Every grade-level math team will have an agenda that will guide their team learning design collaborative. This component's goal is to increase teacher content knowledge by unit and standard.

JEPD Component 2: Team content planning. The second component of each schools' JEPD plan will consist of weekly 45-minute team content planning meetings with the instructional coach. During these meetings, every teacher in each grade level will select instructional tasks and questions, and develop a smaller common formative assessment that will measure each daily objective. The teachers will work with the instructional coach to plan their daily objectives from the learning design collaboration. This process will serve as pre-planning for each teacher's weekly math lesson plan. The intended results are that each teacher will have a weekly lesson plan with activities paced appropriately, questions, and a common formative assessment that is delineated well.

JEPD Component 3: Math content training. The third component of the JEPD plan will include on-site content training from the school's math instructional coach. The training will occur once a month from September through March. The campus-based math instructional coach will provide opportunities for teachers to practice math concepts before they teach them to their students. During this training which will take place after school, the math instructional coach will model specific elements of the math concepts to the teachers to help them deepen their understanding of the concepts. This time is allocated for teachers in the district's professional contract. Each campus will decide which math concepts will be included in the monthly, on-site math content training based on teachers' needs.

Policy Recommendation: Phase 3

Phase Three will delve more deeply into a specific JEPD method: instructional coaching for every school in the district. JEPD methods such as instructional coaching models are not new but provide on-going specialized support that focuses on the way improved instruction will benefit student learning. The addition of the one-on-one JEPD instructional coaching model to this policy recommendation will provide specific instructional changes in the classroom and resources and guidance on the way to accomplish them. In this Phase, instructional coaching will be implemented one-on-one for individual teachers rather than in the form of training sessions with the entire grade level. Individual teachers can request the school coach's support or the school's principal can require the coach to support individual teachers.

Before the beginning of the instructional year, every school principal and his or her instructional coach will review the teachers' background demographic data and MTEBI results and will use this information to design a targeted plan of job-embedded one-on-one instructional coaching support for each teacher. Based on the MTEBI results and teacher background demographic data analysis, the focus of the one-on-one instructional coaching model could include: working with teachers to refine their standards-based math lessons, modeling math instructional practices for individual teachers, and / or implementing instructional coaching cycles with individual teachers. Instructional coaching cycles are opportunities for the coach to conduct instructional walk throughs to observe the teachers' instructional approach with immediate feedback on the best next steps for improvement. The coach and teacher will define a coaching cycle goal before instructional walk throughs begin and develop a goal that will define improvements to the quality of student learning outcomes overall. Finally, the instructional coach will participate in collaborative coaching meetings with the principal to review observations and instructional feedback to determine the next steps to support teachers who participate in a job-embedded one-on-one instructional coaching cycle.

Policy Recommendation Evaluation Plan

The purpose of evaluating the recommendation is to provide the district with an opportunity to appraise each implementation phase of the revised PD plan. The evaluation's objective is to continue, modify or delete the PD plan recommended with the intent to improve teacher instruction and concomitant student outcomes and inform each school's instructional practices better. An outcome-based evaluation is most appropriate to achieve this goal. The goal to improve teacher instructional practices is to improve student outcomes as measured by the state assessment for mathematics. The results of the evaluation plan data will be used to inform teachers' PD needs. In addition, an outcomes-based evaluation provides the requisite data for onsite modification of each school's JEPD plan.

The evaluation's intent is to use the information obtained to improve teacher implementation of best practices learned in JEPD with the ultimate outcome of increased student math achievement. The evaluation is designed to assess the current PD practices and the design and implementation of JEPD recommended. The evaluation will be conducted in two stages. Overall, the goals intended are to increase student outcomes in mathematics by increasing positive responses on the teacher beliefs measurement instrument to increase implementation of reform-based instructional practices acquired through both district-led and job-embedded PD methods. Evaluating the policy recommendation will provide reliable and meaningful results for all stakeholders involved with the design and implementation of the new PD program. To obtain reliable and meaningful results from this evaluation, the goals intended are clarified with an assessment of those included. The key stakeholders include the school board, district superintendent, school district and campus administrators, teachers and teacher teams, and instructional coaches. The evaluation will be conducted in two stages.

Evaluation Stage 1: Teacher Beliefs

First, the results of the MTEBI pre- and post-scores will be analyzed annually to determine whether there is a difference in teacher efficacy before and after they participate in the district's new PD program. The MTEBI contains a Mathematics Teaching Outcome Expectancy and a Personal Mathematics Teaching Efficacy subscale, in which each item is measured on a 5-point Likert scale. The goal is to assess whether there is an increase in positive mathematics teaching efficacy. If not, changes can be made in the new PD program based on an item analysis of the assessment results. The outcome of assessing math teaching efficacy is to determine the continuation, modification, or elimination of the entire JEPD program and all its components.

Evaluation Stage 2: Student Achievement

This stage's goal is to assess student learning outcomes as a result of teacher participation in district-led PD during Phase One, and JEPD during Phases Two and Three. Student math achievement will be assessed using state mathematics assessment scores. The state assessment evaluates the mathematical knowledge, abilities, or specific skills students are expected to acquire. Evidence will be collected from the state accountability report for student performance in mathematics at the conclusion of the school year. Each elementary school in the district will use its report to analyze the performance of students whose teachers participated in both the district-led and onsite one-on-one coaching JEPD. The data will be correlated with the achievement data of students whose teachers participated in the district-led and JEPD program.

Conclusion

The results of the study provided evidence that teacher quality was not related to student learning outcomes. Both district and onsite PD are critical factors in strengthening quality instructional practices and improving student learning outcomes. The purpose of this study was to determine the relationship between teacher participation in district PD and student achievement in mathematics. Based on the study's limitations and results, additional variables of teacher beliefs about teaching and learning mathematics and teacher participation in both district and onsite, JEPD methods, such as instructional coaching partnerships, will be measured to assess the proposed PD changes' effectiveness.

This policy recommendation is grounded in the assumption that teachers want to become more effective to improve their students' learning outcomes. As increased accountability measures lead district policies' effectiveness teachers are seeking specialized supports now more than ever to help them improve their instructional practices' quality and enhance student learning outcomes. PD methods can support teachers' instructional needs in a variety of ways. The social influence of such effective PD methods as sustained, job-embedded methods of PD consistent with the organization's mission and goals to improve student learning is one such positive outcome that will connect current mathematics instruction with the goals to improve the mathematics instruction that teachers aspire to attain.

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Appendix B: The Mathematics Teaching Efficacy Beliefs Instrument (MTEBI)

Mathematics Teaching Efficacy Belief Instrument (MTEBI)

Inservice Teachers

Developed by Larry G. Enochs and Iris M. Riggs, used with permission

Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate letters to the right of each statement.

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1. When a student does better than usual in mathematics, it is often because the teacher exerted a little extra effort.	A	B	C	D	E
2. I will continually find better ways to teach mathematics.	A	B	C	D	E
3. Even if I try very hard, I do not teach mathematics as well as I do most subjects.	A	B	C	D	E
4. When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach.	A	B	C	D	E
5. I know the steps necessary to teach mathematics concepts effectively.	A	B	C	D	E
6. I am not very effective in monitoring mathematics activities.	A	B	C	D	E
7. If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching.	A	B	C	D	E
8. I generally teach mathematics ineffectively.	A	B	C	D	E

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
9. The inadequacy of a student's mathematics background can be overcome by good teaching.	A	B	C	D	E
10. The low mathematics achievement of some students cannot generally be blames on their teachers.	A	B	C	D	E
11. When a low-achieving child progresses in mathematics, it is usually due to extra attention given by the teacher.	A	B	C	D	E
12. I understand mathematics concepts well enough to be effective in teaching mathematics.	A	B	C	D	E
13. Increased effort in mathematics teaching produces little change in some students' mathematics achievement.	A	B	C	D	E
14. The teacher is generally responsible for the achievement of students in mathematics.	A	B	C	D	E
15. Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching.	A	B	C	D	E
16. If parents comment that their child is showing more interest in mathematics at school, it is probably due to the performance of the child's teacher.	A	B	C	D	E
17. I find it difficult to use manipulatives to explain to students why mathematics works.	A	B	C	D	E
18. I am typically able to answer students' mathematics questions.	A	B	C	D	E

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
19. I wonder if I have the necessary skills to teach mathematics.	A	B	C	D	E
20. Given a choice, I would not invite the principal to evaluate my mathematics teaching.	A	B	C	D	E
21. When a student has difficulty understanding a mathematics concept, I am usually at a loss as to how to help the student understand it better.	A	B	C	D	E
22. When teaching mathematics, I usually welcome student questions.	A	B	C	D	E
23. I do not know what to do to turn students on to mathematics.	A	B	C	D	E