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Teachers' Evaluation of Usefulness of Professional Development Activities: Examining Roles of Teacher Collaboration and Administrative Support

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TEACHERS' EVALUATION OF USEFULNESS OF PROFESSIONAL DEVELOPMENT ACTIVITIES: EXAMINING ROLES OF TEACHER COLLABORATION AND ADMINISTRATIVE SUPPORT

by

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ABSTRACT

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This study uses a national sample of middle and high mathematics teachers from the Schools and Staffing Survey (SASS) to predict the usefulness of professional development on mathematics reading instruction. We found that teacher collaboration is significantly related to teachers' perception of useful professional development on mathematics reading instruction. Although administrative support is expected to provide incentives and opportunities for teachers to grow, this study found that it has no influence in teachers' perception of useful professional development in any of the models of the study. With regards to the influence of teacher collaboration and administrative support, our findings showed that teacher collaboration is significant for teachers in non-rural schools but not for teachers in rural schools. However, given the higher standardized coefficient of teacher collaboration in rural schools and the lower sample size compared to nonrural teachers, the difference between the two models may imply that teacher collaboration had substantial influence on the perceived usefulness of professional development by teachers in both rural and non-rural schools. The smaller sample size of teachers in rural schools may contribute to reduced statistical power and smaller likelihood of reaching statistical significance of teacher collaboration therein. Implication for practice and future research are discussed.

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CHAPTER 1

INTRODUCTION

Statement of Problem

The National Commission on Mathematics and Sciences Teaching in the 21st Century (NCMST), chaired by Senator John Glenn (Glenn, 2000) and led by educators and stakeholders, unveiled its report, “Before It’s Too Late”, detailing why United States students lagged behind their peers in many countries. The report published in 2000 found that mathematics and science teachers were not sufficiently trained to prepare their students for the challenges of the future. The Programme for International Students Assessment (PISA) confirmed the NCMST’s alarming report in ranking U.S students 27th in mathematics among the 34-member countries of the Organization for Economic Cooperation and Development (OECD, 2012), an intergovernmental organization of industrialized countries. The PISA is an international assessment that measures 15-year-old students' reading, mathematics, and science literacy skills every three years. Its' mathematics component focuses on measuring students' competencies in applying their mathematical knowledge to solve problems related to a real-world setting. The 2012 PISA results revealed that the U.S performed below average in mathematics; and about 26% of U.S students did not reach the PISA Level 2 baseline of mathematics proficiency. The Level 2 baseline is the threshold at which students begin to demonstrate the skills that will help them to be literate and productive in life (OECD, 2004). Only 2% of U.S students reached the highest level (Level 6) of performance in mathematics, demonstrating a higher level of thinking skills and development of deep content area knowledge. By contrast, 31% of students in China reached Level 6 of performance. U.S students’ weakness in mathematical competencies was attributed to their inability to apply their knowledge and skills in and out of school, adapt to new facts, and interpret and model with mathematics (OECD, 2009). The key area of struggle was their inability to synthesize between real-world scenarios and mathematical representations of those scenarios (OECD, 2012; Friedland et al., 2011). The standardized tests (i.e. SAT, ACT) confirmed the PISA reports of U.S students' struggle with questions in which an emphasis was placed on procedural and conceptual cognitive demands.

Education policymakers and stakeholders express their concerns over the poor performance of U.S students on international tests. Then U.S Secretary of Education Arne Duncan described the results as "unacceptable" and called for the urgency of rigorous reforms. The year 2010 witnessed the most ambitious reform in education in American history. The reform entitled "Race to the Top" approved by President Barack Obama, adopted a comprehensive framework that embedded internationally benchmarked standards and assessments. The reform was committed to preparing students to learn deeply, think critically, and prepare for college and career readiness. It offered bold incentives to improve Science, Technology, Engineering, and Mathematics (STEM) education by supporting the development of assessment systems that better embrace higher-order thinking skills. People in the workplace need mathematical skills to be able to make competent social decisions and to make sense of large amounts of data in a speedy digital society (Vorderman et al, 2011; Hodgen & Marks, 2013). In his pledge to return America as a leader in the STEM industries, President Obama sent a clear message by saying, "If America is going to compete for the jobs and industries of tomorrow, we need to make sure our children are getting the best education possible".

What is Mathematics Literacy?

In 2012, the OECD's report (2012) showed the strength of US students in cognitively less-demanding mathematical skills, which consist of memorizing facts and procedures and applying them repeatedly to problems. However, they failed on items with higher cognitive demands, such as formulating real-world problems into mathematics, developing flexibility in adjusting knowledge skills to new or unfamiliar problems, and interpreting mathematical aspects in real-world problems (OECD, 2012). The National Council of Teachers of Mathematics (NCTM) identifies these skills as fundamental components of mathematics literacy (NCTM, 1989; 2000). The PISA (OECD, 2003) came up with a broad definition of mathematical literacy as "the capacity to identify, understand and engage in mathematics and to make well-founded judgments about the role that mathematics plays in an individual's current and future private life, occupational life, social life with peers and relatives, and life as a constructive, concerned and reflective citizen" (p. 50). Very simply, Oxford Learning (2010) defines mathematical literacy as the ability to solve problems, reason and analyze numerical information, and know the meaning of important mathematical vocabulary. The NCTM (2014a) highlighted in its Principles and Standards for School Mathematics, the process standards of communication and representation as vital tools to help students develop mathematics literacy. It envisions a mathematics literacy classroom where students are encouraged to use speaking, listening, reading and writing to communicate their understanding of mathematics words, symbols, and concepts. Classroom activities should move beyond computation, drill, and rote memorization, and students need to be looking at deeper meanings and understanding of mathematics (Blake, 2017; NCTM, 2014a).

Mathematics reading instruction

To develop a student's mathematical literacy skills, the OECD (2013) has identified three components: (1) writing (e.g., formulate), (2) discussion (e.g., employ, explain, describe) and (3) reading (e.g., interpret). The writing process refers to students being able to recognize and identify opportunities to use mathematics in problem situations and then provide the necessary mathematical structure needed to formulate that contextualized problem into a mathematical form (OECD, 2013). In the discussion process, students explain the relationships between the context-specific language of a problem and the symbolic and formal language needed to represent it mathematically. They defend or provide a justification for the processes and procedures used to determine a mathematical result or solution. Finally, the reading process calls on students to make sense of statements, questions, tasks, objects or images provided and translate that information into a useful mathematical form (Sole, 2014; Doerr & Temple, 2016; Rittle-Johnson & Starr, 2007; Kazemi & Stipek, 2001; Chen & Li, 2008). Among these components of mathematics literacy instruction, research has pointed out mathematics reading instruction as an important step to improve mathematics literacy instruction (Hillman, 2014; Mackay & Wismath, 2012; Adams, 2003). Mathematics reading instruction consists of teaching students how to decode and interpret mathematical sentences, questions, and tasks that enable them to form a mental model of the situation. As a result, the National Assessment of Educational Progress (NAEP), under the guidance of the National Assessment Governing Board (2009a), and the National Council of Teachers of Mathematics (NCTM, 2014, 2000) has placed great emphasis on mathematics reading instruction.

Martinez and Martinez (2001) stressed the importance of reading in a mathematics classroom:

> "[Students]…learn to use language to focus and work through problems, to communicate ideas coherently and clearly, to organize ideas and structure arguments, to extend their

> thinking and knowledge to encompass other perspectives and experiences, to understand their own problem-solving and thinking processes as well as those of others, and to develop flexibility in representing and interpreting ideas. At the same time, they begin to see mathematics, not as an isolated school subject, but as a life subject – an integral part of the greater world, with connections to concepts and knowledge encountered across the curriculum." (p.47).

Mastering mathematics reading skills allows readers to reach the conceptual understanding of the material (NCTM, 2000). The National Assessment of Educational Progress (Lutkus et al., 2003) defines conceptual understanding as a student's "ability to reason in settings that involve careful applications of concept definitions, relations, representations of either" (p.38). This strand involves the ability to provide evidence of comprehension of mathematical texts and the ability to carry out procedures efficiently and flexibly (NCTM, 2014). These procedures support students' analysis built from an initial exploration and experience in incorporating concepts of the material. The National Research Council (NRC, 2012) placed emphasis on students' justification of their choices of procedures through critical evaluation of the material.

Rapid changes in technology and the skills demanded in today's global economy suggest the need to recalibrate the goals of education. Educational researchers, advocates, and policymakers were challenged to design educational policies that respond to young people's cognitive development and their social and economic needs of the 21st century. People need not only the skills but the competencies to thrive in today's global economy (Kahl, Hofman, & Bryant, 2013). More than just knowledge or skills, a competence includes the ability to apply learning outcomes in a variety of contexts (Ambrose et al., 2010). For that reason, the Common

Core State Standards (CCSS) for mathematics placed new emphasis on students' ability to engage meaningfully with mathematics literacy and its overarching goal of applying mathematics to real-life. Mathematics classrooms must change into communities of practices in which learning focuses on improving reading comprehension skills, as one of the important ways that students can make their mathematics thinking plausible (Friedland et al., 2011). A student with solid mathematics reading skills develops the flexibility to transfer mathematical concepts in mathematics texts and to interpret and apply underlying ideas (Hiebert et al, 1996).

Mathematics Reading Instruction for 21st-Century Assessments

The 21^{st}-century workforce requires educated workers to have a higher conceptual understanding of complex concepts. They should be able to critically evaluate what they read, use their critical thinking skills creatively to generate new ideas, new theories, new products, and new knowledge. In 2011, the Partnership for 21^{st} Century Skills (P21, 2011) in collaboration with the nation's mathematics educators, discussed on how mathematics literacy instruction can help students develop skills to lead in the 21^{st} century. P21 focused on the 4C's framework of Creativity, Critical thinking, Communication, and Collaboration as part of mathematics reading skills and offered innovative ways to expand student content knowledge.

Critical Thinking

Critical thinking involves a student having a thorough understanding of mathematical concepts and the ability to use it in a different context or situation. Students in today's mathematical classroom must learn ways to judge the strength of evidence, look for logical structure, and make complex choices and construct viable arguments to defend their choices (Mishra et al., 2011).

Creativity and Innovation

Creativity is an active process embedded in innovation. It begins with curiosity and engages students in exploration and experimentation, involving imagination and originality (Kampylis & Berki, 2014). For that to happen in a mathematics classroom, the teacher must provide students with appropriate learning opportunities that trigger students' flexibility of thought and originality in the responses (Atweh et al., 2012).

Communication and Collaboration

In the mathematics reading class, cooperative learning is an important educational outcome and proven model of 21st-century education (Kastberg et al., 2012; Watson & Chick, 2013). With the advent of technology, students embrace a variety of technology tools and media-rich resources to communicate and collaborate with other students around the country and from other countries and/ or cultures. They discuss and share what they have learned in their mathematics classroom through Twitter, participate in mathematics readings through Google Hangouts, or engage in mathematics competition through Kahoot. These digital resources provide students opportunities to explore the variety of ways that mathematics problems may be solved.

Teacher Role in Developing Mathematics Reading Skills

Reasoning and sense making should happen in every mathematics classroom. To help students read a mathematics text coherently, teachers should provide procedural approaches to engage students in reasoning, considering students' prior knowledge to make the text meaningful (Perin, 2011; Baker et al., 2002). Rather than telling students what the text means, it would be more efficient for teachers to present a problem-based approach, whereby students probe, interpret and analyze mathematical texts. Such tasks should be preceded by purposeful discourse aiming to answer the age-old question "Why do we need to learn this?". It embeds the objective-driven lesson of study, whereby the teacher lays out the groundwork for an approach that will facilitate productive communication between teacher and students. Such communication should include, but not be limited to 1) Analyzing a problem: the teacher's role is to help students apply previously learned concepts to make sense of the problem, identify essential mathematical concepts or procedures, define relevant variables carefully, seek patterns and relationships, and make preliminary deductions and conjectures; 2) Implementing a strategy: the teacher's role in this sequence is to make sure the use of procedures is purposeful or grounded by an understanding of the material, monitor students' progress by asking open-ended questions, and help students make logical deductions built on current progress; 3) Seeking and using connections: the teacher guides the discussion that engages students in understanding how mathematical ideas interconnect. The teacher encourages multiple approaches to solve a problem; 4) Reflecting on a solution to a problem: the teacher helps students justify or validate a solution by discussing the strengths and weakness of different approaches.

Useful Professional Development on Mathematics Reading Instruction

Prior research has documented inconsistencies and lack of communication among teachers and mathematics literacy instruction, as reforms call for a shift to teaching discipline-specific language and literacy practices (Kastberg & Morton., 2014; Fang & Costoam, 2013; Freidland et al., 2011). An increasing number of mathematics teachers express their dissatisfaction with the professional development opportunities they have attended. Mathematics teachers are aware of the urgency of integrating literacy in their classroom but do not see the literacy specialist as a support system for more effective instruction (Freidland et al, 2011). For this reason, a growing body of research started pondering what should be the driving principle of useful professional development on mathematics literacy instruction. The National Staff Development Council (2001) defines useful professional development as a source of knowledge, skills, and improvement for teachers to create and/or promote a high level of learning for all students. Professional development is useful when its processes and activities are sufficiently sustained and connected to daily classroom practice (capable of being put to use), and in turn, enhance student learning (purpose) (DeMonte, 2013). It aims to enhance the professional knowledge of teachers and hone their skills and attitudes toward learning and teaching.

Teacher Collaboration

Teacher collaboration has been evidenced in the literature as one of the most effective methods of learning approach to provide opportunities for teachers to reflect on their practice and to learn from each other (Hsu, 2013; Papadopoulos, Lagkas & Demetriadis, 2017; Hwang, Hung, & Chen, 2014; Alsaleh et al., 2017; Zhang, Liu, & Wang, 2017). Research on teacher social support has recently identified teacher professional learning communities (PLC's) as one of the ideal settings of teacher interaction (Darling-Hammond et al., 2017) and may, therefore, influence teacher attitudes toward learning and teaching. Therefore, scholars have focused their attention on norms that support teacher collaboration through which improvement in instructional practice can flow. Like any community of practice, learning and growth are intertwined with differences in instructional approaches and divergence over strategies. Therefore, researchers have pondered this matter with the utmost consideration by studying norms to help create and/ or consolidate relational trust among teachers and prevent sources of isolation of teachers from one another (Smith & Stein, 2011; NCTM, 2014). Norms are built upon social and political competences of educators who shape the tone of teacher communities of practice (Achinstein, 2002). These educators are colleagues or school leaders, to whom teachers refer for professional advice and guidance.

Freidland et al. (2011) pointed out the importance of teacher collaboration as one of the key factors of successful professional development to cross the mathematics-literacy divide. Mathematics teachers should teach reading and writing skills to ensure their students' ability to read and write in mathematics (Common Core State Standards Initiative, 2010). For that reason, the vision of mathematics literacy defined by the Principles of Standards for School Mathematics and supported by the Common Core States Standards for Mathematics (CCSSM) reforms stressed designing new models of professional development that focus on close collaboration among teachers. To ensure a coherent implementation of the CCSSM, professional development should build a framework that could be the foundation for a common proficiency conversation. The NCTM urges the creation of a forum for teachers throughout a district to refine and develop teaching practices and to deepen their content knowledge of mathematics reading instruction (NCTM, 2010).

Administrative Support

Research on a school's improvement has pointed out the importance of administrative support in all components of school capacity (Kim et al., 2013; Bays & Crockett, 2007; Albrecht et al., 2009). School capacity is referred to as the perceived ability, skills, and expertise of a school to grow, progress, improve, or to accomplish a specific goal. The quality of administrative support can affect aspects of a school capacity, for better or worse, and among them, affect the professional learning community of teachers. For instance, a significant body of research has underscored the role of a principal in defining school policies that affect the entire school culture, as well as the performance of teachers and students (Kim et al., 2013; Bays & Crockett, 2007). The principal's role is a catalyst in creating conditions under which teachers are eager to hone their skills and develop new practices of teaching mathematics literacy. For this to happen, it is important for the principal to implement guiding principles and policies that support these reforms, and that teachers buy into these reforms (Howard, 2015; Peled, Kali & Dori, 2011; Phillips, Desimone & Smith, 2011). The success of these policies depends on effective responses of principals in setting clear goals to direct educational change and to support teachers' needs (Claro et al., 2016; Alghamdi & Prestridge, 2015).

Administrative support in general should invest in the provisions of specific guidance in designing professional development that lead to a coherent interpretation of reforms by teachers. d'Entremont et al. (2013) argued for the necessity of school leaders to invest in the provision of daily interaction time for teachers. Mathematics reading instruction will benefit from increased teacher interaction time to develop instructional support aligned to teachers identified classroom challenges (Borko et al., 2010; Siebert & Draper, 2008). Extant research has suggested that school leaders restructure school time to allow for one period of collaborative planning each week (Jao, & McDougall, 2016; Borko et al.; 2010; Boyd & Hord, 1994) and for daily opportunities for teachers in school-wide, departmental, or grade-level teams (d'Entremont et al., 2013).

School Urbanicity

Teacher access to, and participation in, professional development opportunities have been a plight to many remote schools. Rural schools have less access to certain types of professional development compared to their urban or suburban counterparts (Wei, Darling-Hammond, & Adamson, 2010). University-sponsored and federal-funded professional development are more likely to be held in large or dense districts, as funders target larger numbers of students; thus, disadvantaging property-poor rural districts with fewer resources to fund their own professional development programs (Mattingly et al., 2011; William, 2012). As schools become more remote, they face financial constraints that hinder their ability to engage in successful school improvement plans. These constraints include but are not limited to, low fiscal capacity, greater per-pupil costs, reduced management support services, and less competitive salaries and benefits (Mattingly et al., 2011). Rural districts face enormous challenges not only to fund professional development for teachers but also to find qualified substitutes to cover teachers' absence (Harmon, 2003).

Rural schools are less likely to attract and retain highly qualified mathematics teachers, as teacher migration headed away from remote areas (Miller, 2012). The reasons for such trends are attributed to teacher low salaries in rural areas, general funding inequities that mostly profit urban schools, and the geographic isolation of rural areas. The SASS data revealed that in 2011-2012, rural teachers made a national average starting salary of $33,200, compared with the $40,500 earned by their suburban counterparts (Center for Public Education, 2018). The data also showed that the attrition rate for rural teachers is 8.4 percent, compared with 7.3 percent for suburban teachers and 7.9 percent for urban teachers (Center for Public Education, 2018). Moreover, rural schools face not only difficulty filling teaching vacancies but also finding qualified applicants for these vacant positions. To reduce the gap of teacher vacancy, rural schools have no other option but to hire more teachers teaching outside their specialty area (Lazarus, 2003) and novice teachers (Gagnon & Mattingly, 2014). While rural areas have the potential to cultivate social cohesion and acceptance, findings revealed that educators in those schools' experience personal and professional isolation (Erlandson, 1994; Jarvis, Pell, & McKeon, 2003).

Culture and community fundamentally influence mathematics education in rural schools.

Although there is no significant difference in mathematics achievement between rural and non-rural schools (Howley & Gunn, 2003), students in rural schools encounter fewer mathematics courses offered, due to the dearth of qualified teachers (Gagnon & Mattingly, 2014). They are less encouraged to study advanced mathematics because most jobs and career readiness in rural areas do not view knowledge of mathematics as fundamental requirements (Flores, 2007).

The Challenge of Useful Professional Development on Mathematics Reading Instruction

Research on teachers' education showed that teachers failed to engage their students in mathematics reading instruction. Teachers were not trained to teach curriculums with an emphasis on cognitive and conceptual demands (Griffin & Jitendra, 2009; Fuchs et al.; 2008). Students regarded mathematics as an isolated school subject rather than a life subject (Martinez and Martinez, 2001). Moreover, students were not sufficiently exposed to "opportunities to appreciate connections between mathematical ideas to understand the mathematics behind the problems they are working on" (Hollingsworth et al., 2003, p.21). Rather, they were exposed to either solve problems with low procedural complexity, with little connection to real-life settings, and/or with rare reasoning involvement. Teachers devote much of their instructional time assessing students' ability to regurgitate procedures and steps learned in solving specific problems. The main rationale behind teachers' attitude of teaching is attributed to their lack of experience in content literacy strategies in their own educational background. Thus, they often carry these deficiencies into their teaching profession (Zeichner, 2010; Perin, 2011).

Mounting evidence suggests that the effectiveness of professional development depends on how carefully teachers and school leaders conceive, plan, and implement it (Boyd et al., 2011; Ronfeldt et al., 2015; Loeb, Darling-Hammond & Luczak, 2005). Teachers who work in a supportive environment become more confident and more effective than their counterparts who work in less supportive environments (Ronfeldt et al., 2015). The current study hypothesizes that teacher collaboration and administrative support can contribute to the planning and offering of professional development sessions that provide mathematics teachers with a model for crossing the mathematics-literacy divide (Freidland et al., 2011). School context in which teaching and learning occur can have a significant impact on teachers' attitudes and behaviors toward teaching and learning (Ladd, 2011; Papay & Kraft, 2012). Furthermore, this study hypothesizes that the influence of teacher collaboration and administrative support on the usefulness of professional development on mathematics reading instruction differs by school urbanicity.

CHAPTER 2

REVIEW OF LITERATURE

The Common Core State Standards (CCSS) reforms accepted by many states placed a greater emphasis on high-stakes subjects (e.g., mathematics) to address the challenges encountered by U.S education. The CCSS reforms for mathematics aim to improve students' ability to engage in mathematical practice such as modeling mathematically real-world situations, and interpreting and critiquing real-world aspects and arguments. Under the goals set by the reforms, the NCTM published higher order thinking-based curriculum and evaluation standards that carried out the importance of students' ability to communicate, read, write and discuss mathematically. The new curriculum replaced the traditional approach that conveyed the arithmetic-based learning that focused on algorithms and rote memorization. This requires teachers to teach knowledge that develops critical thinking skills and performance. One of the factors examined by the literature on mathematics education is how to create opportunities for active learning by educators through professional development. In the last two decades, researchers have committed to designing “useful” professional development opportunities that help teachers engage students in mathematical discourse, whereby they probe, interpret and analyze mathematical texts.

Mathematics Reading Instruction

A Problem-Based Approach to Teach Mathematics

Research on students’ learning and thinking has led to significant progress in designing mathematics classroom as communities of practices, where students learn to make sense of mathematical concepts (Perin, 2011). Research illustrates that teaching students to understand and love mathematics would not be possible without a thorough enrichment of teaching practice from reading and language arts adjusted to cognitive science (Kahl et al., 2013; Manouchehri, 2017). Although research on mathematics instruction has undergone important changes and practices on reading, it has not yet had a significant impact in students' achievement (Gregory, Ellis, & Orenstein, 2011; Kastberg et al; 2012). Teachers failed to implement instructional strategies to guide students through the reading process. One reason for this failure was that traditional mathematics instruction focused on text-based strategies, where students view math as abstract terms, intangible and incomprehensible formulas and concepts (Wang et al., 2017). Success in reading a mathematics text heavily depends on the readers' mathematical competency to build a symbiotic relationship with the printed text. Mathematical competency is measured by how well they can transfer their knowledge to novel problems. Exploring a text is an ongoing process grounded by inquiry and reflection to create a symbiotic relationship between the text meanings and the readers' meanings (Kahl et al., 2013, Cohen, Brawer, & Kisker, 2014). Such process calls on readers' past experiences and socio-cultural context to model a framework and organize and process information from the text. The instructional phase moves away from the teacher's prescribed answers to students' approach to connect with the text (Rosenblatt, 2005).

Model of Effective Mathematics Reading Instruction in a Mathematics Classroom

In a case study, a teacher presents the class with the following problem—explore different ways of tiling a floor using triangular tiles of a single size and shape. The case study uses the 4C's framework to design a procedural approach to helping students make sense of the problem (P21, 2011). Teacher's initial role is to help students make sense of the problem: identify essential mathematical concepts of angles and line segment relationships. Students construct viable arguments about the relationship between angles formed by a transversal of two parallel lines.

The teacher monitors students' progress by asking open-ended questions and helps students to make logical deductions as they make sense of the problem. Students expand content knowledge by making a connection between the property of parallel lines cut by a transversal and the fact that the sum of interior angles of a triangle is 180 degrees. They use slopes of equations of lines to investigate geometric relationships, including parallel lines and perpendicular lines. The teacher divides the class into small groups and students construct an appropriate graphical representation of triangular tiles of a single size and shape. Tasks require students to communicate mathematical insights, share their ideas and collaborate on the group's work as a whole. Each group prepares a report for the rest of the class explaining ways of tiling a floor using tiles of a single size and shape. Reporter of each group "teaches" the class and assigns follow-up work to assess the class. Students listen effectively to the reasoning of each group, critique in order to decrypt a peer's solution to the mathematical problem, evaluate feedback, and revise their own arguments as needed.

Usefulness of Mathematics Professional Development that Focuses on Reading Instruction

The CCSS for mathematics has placed a great emphasis on the development of mathematics reading skills to prepare students for the mathematical demands of living and working in the 21st century (Sammons, 2017). For this to happen, the National Mathematics Advisory Panel (2008b) insisted on teachers' readiness to prepare their students to be mathematically literate. Mathematics literacy continues to flounder due to the traditional whole-class instruction model as a dominant mode of instruction in today's school. Research on teacher attitude toward literacy has found that personal experience shapes attitudes toward pedagogical learning (Lesley, 2011) and teachers tend to teach the way they were taught (Zeichner, 2010, Perin, 2011). They need more training to strengthen their understanding of change in instructional practice imposed by mathematics reading instruction, a major component of mathematics literacy. Wang et al. (2017) stress that to effectively build mathematics literacy, teachers must have a strong understanding of subject matter knowledge to capture "big ideas" in any given area of learning, and of pedagogical content knowledge to understand students' thinking and learning.

Research pointed out the urgency to invest in useful professional development activities, with emphasis on helping teachers not only to learn how to teach literacy in mathematics but to become engaged as "practitioners" (Zhang et al., 2017, Jalani & Lai, 2015; Crooks & Alibali, 2013; Merritt et al., 2017; Clements & Sarama, 2014; Sole, 2016). The NTCM (2013) pointed out the intentional process that must underline useful professional development. Useful professional development must be a deliberate process, where teachers' motivation should be guided by a clear vision of purposes and planned goals to bring positive change and improvement in the classroom, and in turn, improve students' learning. Useful professional development with emphasis on mathematics reading instruction engages teachers in making sense of mathematics texts, exploring ways students can use models to communicate and justify mathematical ideas (Crawford-Ferre, Wiest, & Vega, 2016; Hillman, 2014; Doerr & Temple, 2016). Emphasis is placed on learning how students' attention to mathematical information is related to their performance, and what students can do at various ages (Clements & Samara, 2014; Zhang et al., 2017). For that, teachers are encouraged to create opportunities to individualize the mathematics teaching styles, analyze and refine curriculum and students' assessments to fit local context (Sole, 2018; McLaughlin & Talbet, 2001; Porter et al., 2011). This phase is an ongoing process grounded by inquiry and reflection to model a framework for processing information from a mathematics text. It allows teachers to discuss in-depth pedagogical strategies of teaching and learning, and to explore new concepts and ways to enact pedagogical strategies in enough depth (Jalani & Lai, 2015; Zhang et al., 2017). Garet et al (2001) called it a reform-oriented professional development because of its ongoing and systematic process, where teachers are engaged in study groups, internships, mentoring and coaching. Research on school improvement suggests that a useful professional development depends on the extent to which it promotes a sense of security that values risk-taking, and builds confidence and competence (Kilpatrick & Swafford, 2002; Borko et al, 2008). For this to happen, teachers and school administrators should not go the distance alone, rather they should use collaborative dialogue to address underlying obstacles to student achievement (Fuhs & McNeil, 2013).

Teacher Collaboration

Setting mathematics literacy as a main curricular focus requires a transparent process of inquiring and structuring problems by teachers. For this to happen, it is important that teachers create opportunities for informal interaction with peers during professional development activities to address obstacles to student achievement (Darling-Hammond et al., 2017; Perin, 2011; Baker et al., 2009). Many mathematics teachers are not trained in higher-level mathematics reading or literacy instructional strategies (Gregory et al., 2011; Kastberg et al., 2012). They need to see problem-solving models of how to use reading strategies in mathematics and be given opportunities to practice. Therefore, it is important to put in place an effective teacher collaboration that creates a balanced synergy among teachers' different views of teaching strategies (Watson & Chick, 2013; Jordan & McDaniel, 2014). An effective collaborative effort among school staff members turns a school culture into a collaborative work environment, where teachers and administrators set expectations for shared responsibility to advance school's improvement reform (Jordan & McDaniel, 2014). Shared responsibility promotes teachers' freedom and trust in their quest for new approaches to instruction (Hwang et al., 2014). The stress of teaching mathematical reading demands teachers’ commitment to take challenges. Research has shown that school attaining higher levels of collaboration extend teachers’ collaboration with peers beyond formal teaming structures (Tait-McCutcheon & Drake, 2016; Moller et al., 2013); for example, teachers share common planning period, observe each other and debrief teaching practice.

In a study of school improvement using teacher influence to coordinate curriculum, interventions, management, and parental communications, research has found that the more teachers collaborate, the more they improve knowledge of student performance, teamwork (Engin & Atkinson, 2015), and parental communication (Pounder, 1999). Moreover, research on school improvement found that collaboration among teachers improve teacher’s knowledge base (Nordin, 2012; Olson, 2015; Blakely, 2015; Florman, 2014), reduces gaps in mathematics achievement by race /ethnicity and socioeconomic status (Moller et al., 2013), establishes more equitable learning environment (McLaughlin & Talbert, 2006), and increases teachers’ sense of efficacy (Duchaine et al., 2011). Although not related directly to student achievement, these results implied that there is a link between teacher collaboration and student achievement. To evaluate teachers and schools, Goddard et al. (2000) used high-stakes assessments (mathematics and reading) to provide evidence of positive association of teacher collaboration and student achievement. Their results controlled for the effects of school social context (school SES, size, and minority proportion) and student characteristics (race, gender, SES, and prior achievement). When teachers participate in professional development to coordinate instructional strategies, curriculum, and student assessment, their collaboration is positively related to their performance and student achievement (Ronfeld, 2015).

Improving teacher collaboration is so important that it has led to a focus on professional development as an important way to help teachers build knowledge, skills, and confidence to teach mathematics literacy (Cady, Meier, & Lubinski, 2006, Freidland et al., 2011). In his study of beginning teachers with fewer than five years of experiences, Campbell (2005) found that preservice programs that focus on teacher research are more likely to help teachers carry their learning about teacher collaborative research in their own classroom. Studies went further in highlighting the transformative experience of teachers involved in collaborative research, such as flexibility and receptive to educational change (Jordan & McDaniel, 2014), higher self-efficacy and confidence levels (Settlage et al, 2009), creativity and honesty about classroom issues (Mohr, 2001). Although there is little evidence of the association of teacher collaborative research and improved student learning, studies have shown significant improvement in student attitudes, involvement and behavior toward learning (Zeichner, 2005).

This study identifies five observed indicators to capture the level of teacher collaboration:

Teachers Share the Same Beliefs About School Mission

A coherent and effective mathematics literacy program should be guided by appropriate content standards and be supported by clear and shared beliefs about school mission (Zakrzewski, 2013; McLaughlin & Talbert, 2006; Wood & Whitford, 2009). Additionally, in their effort to develop sustained professional learning communities, teachers must put in place standards and protocols for handling conflict that is linked to shared goals (Carpenter et al., 2014). These two actions are interrelated and hold teachers and administrators accountable to develop resources, workshops, and projects that improve students’ achievement.

Peer Observation

Bell (2005) provided an extensive definition of peer observation as a "collaborative, developmental activity in which professionals offer mutual support by observing each other teach; explaining and discussing what was observed; sharing ideas about teaching; gathering students' feedback on teaching effectiveness; reflecting on understanding, feelings, actions and feedback and trying out new ideas" (p.3). Peer observation promotes partnership among teachers and turns a classroom into a forum, where teachers disseminate best practice of teaching (Kahl et al., 2013; Hammersley-Fletcher & Orsmond, 2005) and develop an effective model of peer and self-assessment (Napan & Mamula-Stojnic, 2005). In addition to the development of strong collegiality and great morale among teachers, peer observation promotes the development of confidence to teach and to deepen knowledge of teaching (Engin & Atkinson, 2015). Building a sustainable peer observation system begins with implementing a healthy environment that fosters teachers to work together and to provide non-judgmental and constructive feedback (Lomas & Nicholls, 2005). Peer observation also creates a structure for productive conversation between teacher leaders and teachers. Together they strengthen frameworks to develop teaching strategies for conceptual understanding through meaningful mathematical problem solving (Lee & Chen, 2009). Through the lens of effective peer observation, school leaders can build a shared understanding of mathematics reading instruction and increase the capacity for supporting teachers' collaboration.

Teachers Coordinate Content of Course with Each Other

Research in education supports the usefulness of teachers' sharing content of courses with each other for several reasons. It provides a shared experience for teachers and students so that the classes complement each other (Barnard et al., 2011). It enforces intellectual interaction among teachers and between teachers. Teacher-linked courses content shows an increase in curricular coherence and promotes opportunities for the integration and the reinforcement of ideas among teachers (Kahlenberg & Porter, 2015; Bramschreiber, 2013). It promotes teachers' practice of writing across the curriculum as they discuss issues including pedagogies, goals for students learning, and possible challenges they face in making the steps in the reading process of mathematical texts accessible by every student (Coburn & Woulfin, 2012).

Reading a mathematical text is something that does not come naturally to most students for several reasons that include, but is not limited to, a discrepancy between meanings of mathematical words and their meanings in other contexts (Clements & Sarama, 2014), and undeveloped analytical reading skills of students. When teachers coordinate their courses' content, they are able to share literacy instructional strategies, types of reading, research/inquiry, and the gradual release framework that will help students learn the content (Coburn et al., 2010).

Teachers Engaged in Collaborative Research

The last two decades witnessed an emerging paradigm of professional development that focused on creating a consensus about its content, context, and design (Tait-McCutheon & Drake, 2016). Teachers became more and more aware of the demands of the 21st century that highly value citizens with higher-order thinking skills. Recent national surveys reported an active involvement of teachers in collaborative research that focuses on student learning, pedagogical skills, assessment, observation, and curriculum reflection (Darling-Hammond et al., 2017). The adoption of the Integrated Mathematics Assessment (IMA) has put more emphasis on the development of professional development on mathematics reading instruction. The IMA is an inquiry-based instructional practice that directly engages teachers in collective work to raise issues, take a risk, and address tough challenges of their own practices (Merritt et al., 2017). In the IMA approach, teachers videotape their teaching for peer review, condense their effort on students' conceptual understanding, anticipate and address students' misunderstanding (Sherin, 2004).

There is a Cooperative Effort Among Staff Members

The organizational structure of any school is dependent on the level of cooperative effort among its staff. A cooperative school is built on strength of a team-based structure, which unfolds, but is not limited to, faculty collegial support groups and collegial teaching teams (Ahn, 2014; Willems & Gonzalez-DeHass, 2012, McAlister, 2013). Faculty collegial support helps teachers "stay alive" by facing the challenge of learning from their own practices of teaching mathematics literacy (Wilson et al., 2013). It provides a supportive working environment where teachers feel free to share their triumphs and disappointments, their questions and concerns about students, schools, curriculum, teaching, and learning (Harris & Anthony, 2001). A collegial teaching team provides a general degree of emotional support and a safety net and promotes risk-taking behaviors. Mathematics literacy has called for a shift in the approach of teaching that fosters classroom discourse and conceptual development (Thompson & Rubenstein, 2014). Such an approach needs teachers to engage in mathematics discourse where sharing ideas cohabitate with risk-taking, failure, and criticism (Sullivan & Mornane, 2014).

Administrative Support

Corburn (2003) stated that "the more challenging a reform is to teachers' existing beliefs and practices, or the more aspects of classroom practice or levels of the system it engages, the more it may need well-elaborated materials and sustained, ongoing professional development to achieve depth" (p.9). For this to happen, it is important for school leaders to implement guiding principles and policies that support these reforms and professional development, and in which teachers will buy into it (Hwang, Chu & Yin, 2017; Phillips, Desimone & Smith, 2011). Administrative support is a catalyst in creating the conditions under which teachers are eager to hone their skills and learn their way of new practices of teaching mathematics literacy (Shepard et al., 2005). The role of school administrators is to put in place inclusion approaches that promote development toward a "standard of competence, development of a personal orientation towards teaching, and reflective inquiry" (Van Huizen et al., 2005; p. 285). Among these inclusion approaches, research upheld ingratiation, exchange, rationality, assertiveness, upward appeal, and coalitions, as contributing factors to enhance teacher's effectiveness in organizational settings (Alvoid & Black, 2014). Current research relating to the teacher-administrator relationship has yet to comprehensively grasp all of its main constituents. Even though promoting teacher participation in effective professional development is an overarching goal of state-level policies, policy environments are more influential when they are closest to teachers.

Administrative support is expected to provide incentives and opportunities for teachers to grow (Phillips et al., 2011). Phillips et al. (2011) found that factors measuring administrative support are significant in predicting teacher participation in mathematics content-focused professional development. These factors include the alignment of professional development with school policies, the influence of school administrators on school policies, and the control over classroom practice. Administrative support measured by the degree to which supervising administrators facilitate or hinder self-reflection and growth in a teacher is a significant contributor to predicting teachers' willingness and readiness to carry out their instructional responsibilities (Renzulli, Parrot, & Beattle, 2011). These measures include assistance for new teachers, greater teacher autonomy, and greater faculty influence on school policies. Methner (2013) further contributed to this notion by measuring administrative support through the lens of instructional improvement, feedback, discourse, reflection and growth, and teacher anxiety; he found that only the construct reflection and growth was predictive of teachers' sense of efficacy. Recent research on micropolitics in education claimed that hard work and intelligence are core requisites to be an effective leader (Boyd et al., 2011; Hargreaves & Fullan, 2012). Moreover, the research found that performance, effectiveness, career success, social astuteness, networking, positioning, and savvy are contributing to the success of a leader. Teachers' attitudes and behaviors are influenced by the support they have from their leaders (Darling-Hammond et al., 2017; Alvoid & Black, 2014; Branch, Hanushek, & Rivkin, 2012). Research has found that administrative support measured trust and high willingness is a significant contributor to successful change initiatives in high schools (May & Supovitz, 2011).

The study uses four observed indicators of administrative support:

Teachers have Regular Supportive Communication

Mathematics literacy requires a huge paradigm shift for teachers, as they move away from traditional ways of teaching. Teachers must prepare students to be self-regulated learners and to fully understand the developmental trajectory of a given skill and apply it in real-time. School leaders need to acknowledge the paradigm shift as a very challenging transition because most teachers lack the skills to teach mathematics literacy. To support the self-regulation development, supportive communication is critical between school leaders and teachers to eradicate teachers' own anxiety and work with them to develop a plan that aligns with identified classroom challenges (Cohen et al., 2014; Peurach, 2011; Quint et al, 2014). Such support boosts teachers' confidence and their willingness to experiment and adopt new teaching mathematics strategies. In addition, supportive communication requires school leaders to put in place coherent policies and protocols for collaboration with teachers (Talbert, 2010), and a coherent schoolwide reform message (Coburn, 2001) that accompanies the reforms of mathematics, and in which teachers will buy into it. Success of these reforms depends on the effectiveness of school leaders in setting clear goals to direct educational changes in a way that make opposing views visible and to work with teachers individually, and to actively respond to conflict (Pourschafie & Murray-Harvey, 2013; Cosner, 2009; Coburn, 2001).

The Principal Communicates the Kind of School Desired

Principal leadership has a great impact on all components of school capacity. The principal is responsible for laying out the kind of school desired, which guides the mission and the vision of the school, and influences the professional learning community of teachers. When the principal communicates the kind of school desired, he/she use authority and power to reinforce its implementation (Phillips et al., 2011). Teachers abide by policies because of its authority, (i.e. principal' influence over school policy, principal' control over classroom practices) or power (i.e. principal supervises and observes teachers, barriers to dismissing teachers) (Phillips et al., 2011; Desimone, 2013). Research has shown that policies supported by authority enjoy the buy-in of teachers and are more likely to become stable, while policies tied by power seeking to either punish or reward teachers' performances are more likely to result in short-term implementation or be doomed to failure (Phillips et al., 2011). Principals and administrators, as part of the school improvement team, should invest in teachers' learning by connecting professional development to their learning goals (Sun et al., 2013), providing technical resources that include quality curriculum instructional materials and adequate workspace (Ronfeldt et al., 2015). Such professional development should consider the context of teaching and teachers' experiences (Remillard & Heck, 2014).

Staff Members are Recognized for the Job Well Done

Recognizing staff members for a job well done is one of the key assets to motivate them to reach their full potential (Hanushek, 2011). The 1990's witnessed the emergence of incentive programs designed to recognize employee's efforts and reward them based on their performance. Incentives, both formal and informal, recognize staff members' contribution to school improvement. Research provided evidence that deliberate recognition and reward of staff performance boosts positive behaviors and engagement, build a culture of high performance (Chetty, Friedman & Rockoff, 2014a). To get optimum results from the recognition and reward scheme, it is important that school administrators thoroughly set integrated policies, guidelines, processes, and practices to fairly reward staff members (Kelly & Dikkers, 2015; Lawler, 2003). Lawler (2003) argued that principals must be on the front lines supporting mathematics teachers in the professional learning seminars. To praise teachers for success or to reward them, leadership must know what the new mathematics literacy process looks like in a classroom and be able to provide constructive feedback and encouragement to teachers (Lawler, 2003; Goldring, Cravens et al., 2015).

School is Well Run

Although teachers play an important role in school improvement, it is important for school leaders to create a school culture that foster teachers' engagement as agents of change. Research on school improvement suggests that a school is well run when its leaders focus on people and practices (Murray, 2011). Therefore, the success of school improvement efforts is dependent upon creating a school culture that enhances collaboration and collegiality among the school's members. Although each school constituent plays an important role in school improvement, it is fundamental to describe how each constituent's learning will be assessed. These assessments should be grounded by one purpose: improve students' learning. To prevent educators from making decisions that would adversely affect students, feedback from assessments should be frequent, constructive, and purposeful (Reeves, 2010). Moreover, school administrators should look for consistency between instructional strategies proposed by teachers and the norms of the curriculum standards, and support the ones that highly strengthen students' understanding and learning (Draper & Siebert, 2004).

School administrators define policies that structure mathematics literacy professional development to move beyond teaching self-contained instructional strategies and learn the theory (the why) embedded in them (Shepard et al, 2005). The success of these policies depends on effective responses of school administrators in setting clear goals to direct educational change and to support teachers' needs (Turnbull et al., 2013; Prestridge, 2012; Alghamdi & Prestridge, 2015). These policies provide an operational framework within which decisions, actions, and activities happen, and in turn influence teachers' disposition, for better or for worse, depending upon its qualities.

School Urbanicity

Whether they are offered offsite, onsite, or online, non-rural schools provide more teacher professional development opportunities than rural schools (Koricich, 2014). The discrepancy is considerable in the collaborative learning activity and formal learning activity (Mills & Millsteed 2002; McCoy 2009. Out-of-field teaching in core subjects, such as mathematics and sciences, continue to gain ground in rural areas (Sharplin, 2014; Hobbs, 2012), while series of attempts to improve substantive knowledge through professional development fail because of resources and limited time (Balfour, De Lange & Khau 2012).

In collaborative learning activities, non-rural teachers receive more administrative support, especially in areas that focus on student learning, pedagogical skills, assessment, observation, and curriculum reflection (Peltola et al., 2017). Collaboration protocols are very important for setting ground rules and guidelines that encourage productive conversations between and among teachers and administrators. They are more prevalent in non-rural schools and school leaders in those schools are more concerned about building comfort and a great atmosphere that welcomes constructive and collaborative conversation among teachers (Eargle, 2013). Common planning and collaboration are the major supports for teachers to access professional development. These supports are significantly less prevalent in rural schools than in non-rural schools (Peltola et al., 2017). In planning teacher professional development, non-rural principals surpass their rural counterparts in selecting professional development that support their school's or district's improvement goals, addressing teachers' instructional needs, and supporting teachers' use of student data (Hale & Moorman, 2003). Instructional leadership is the hallmark of school improvement, as documented in the literature on school improvement. A large proportion of rural principals are concerned about the leadership needed to meet the new expectations of their roles of setting formal accountability procedures, goals for outcomes, formally assigned group leaders, and online space for sharing ideas and resources. Provision of professional development for school leaders is less prevalent in rural schools than in non-rural schools (Renihan & Noonan, 2012).

Research Objectives

The objective of this study is to predict the usefulness of professional development with emphasis on mathematics reading instruction. Although there are several possible predictors of success, this study chose ten potential predictors. Those predictors fall into two categories: teacher collaboration (teachers shared the same belief about school mission, peer observation, peer collaboration, there is a cooperative effort among staff members, teachers coordinated content of course with each other, and teachers engaged in collaborative research), and administrative support (teachers had regular supportive communication, Principal had communicated the kind of school desired, staff are recognized for the job well done, and school is well run). The study examines how teachers' evaluation of the usefulness of professional development is related to teacher collaboration and administrative support, and how the relationships may vary by school urbanicity. The study uses a general linear model and multiple regression analysis to predict the usefulness of professional development on mathematics reading instruction.

The standards-based reforms place a greater emphasis on teacher quality and accountability. This sets high standards for teachers and a reliance on professional development to improve their mathematics reading instruction. The study examines the influence of teacher collaboration and administrative support on the usefulness of professional development on mathematics reading instruction. In that respect, the study is challenged to answer the following questions:

- To what extent do teacher collaboration and administrative support contribute to teachers' perception of useful professional development on mathematics reading instruction?
- How are the influences of teacher collaboration and administrative support on teachers' perception of useful professional development on mathematics reading instruction different for non-rural schools vs. rural schools?

Although several researchers suggested no significant correlation between teacher experience and teacher collaboration (Tschannen-Moran, M., 2004; Louis, K. S., Kruse, S. & Marks, H., 1996), other research has found that teacher experience plays an influential role in teacher practices and beliefs (Ostovar-Nameghi & Sheikhahmadi, 2016). Moreover, less experienced teachers proximally tend to collaborate more often than experienced teachers; and teacher level of education influence the teacher's ability to profit from collaborative interaction (Ronfeldt, 2015). Research has suggested that teacher background variables, such as teacher level of education and teacher experience contribute significantly to effective teacher professional development (Zhao & Frank, 2003; Desimone, 2009; OECD, 2009). The study accounts for teacher level of education and teacher experience that previous research has shown to be associated with teacher collaboration. The proliferation of federal government funding in non-rural districts drives more professional development (Elmore, 1993) to set goals for teacher growth. This study expects more useful professional development in non-rural schools due to higher teacher concentration and more specialized programs (Hannaway & Kimball, 1997). As the literature suggests, usefulness of professional development is more likely conditional to school urbanicity (Mattingly et al., 2011; Wei, Darling-Hammond, & Adamson, 2010). The study assumes that non-rural teachers' perception of useful of professional development on mathematics reading instruction are unrelated (i.e., uncorrelated) with their rural counterparts.

CHAPTER 3

METHODOLOGY

This study explored factors, including teacher collaboration and administrative support that might be influential in creating opportunities for active learning of educators through professional development. The study used the data from the 2011-2012 school and Staffing Survey (SASS12). This chapter provides details of the research design, including the preparation and analysis of the data, criteria for items selection to operationalize variables and constructs identified in the review of literature, and the test research hypotheses. To empirically assess the hypothesized models, statistical software SPSS was used to perform the regression analysis.

Data Sources

Origin of the Data

The NCES (National Center for Education Statistics) provided the data from the 2011-2012 Schools and Staffing Survey (SASS). The data is currently the largest and most complete survey of school districts, schools, teachers, principals, and library media in the United States. The survey, collected from each state education agency, started with a nationally representative sample of teachers, school administrators, and schools. The sampling frame for public schools came from the Common Core of Data (CCD). The survey was designed, not only to give policymakers valuable statistics of the trends and challenges of education in America, but also to examine issues, including but not limited to general conditions in schools, school programs, teacher demand and shortage, and teacher and administrator characteristics (U.S Department of Education, 2002). It was the only available dataset with information that makes it possible to examine the relationships and trends between the types of professional development teachers participated in and relevant schools and states policies (Phillips, Desimone & Smith, 2011).

In the 2011-2012 SASS, the survey was mailed to a representative sample of teachers using a stratified sampling design. Although the survey consisted of a web-based questionnaire, teachers could request to take the paper questionnaire. Data for SASS components were collected during a single school year. Questions for teachers about current teaching loads referred to the most recent full week that school was in session, and questions on professional development referred to the past 12 months. The U.S Census Bureau collected the data using the survey and proceeded the follow-up efforts about two weeks after the survey was first distributed. Follow-ups consisted of telephone calls and field interviews with teachers who failed to return their questionnaire (NCES, 2013)

Description of Participants

The participants of the study came from selected public schools of the SASS12 survey. This study restricted the sample to teachers whose mathematics is their general field of main assignment (ASSIGN03=8). Then, the study parsed the sample to include full-time and part-time teachers. This study classified schools as rural or non-rural based on definitions established by NCES that considered a school's demographic location relative to urbanized areas and clusters identified by the U.S. Census Bureau. Therefore, schools designated by NCES with either city, suburb, or town locale codes were classified as non-rural.

Preparation of the Data

The following preliminary considerations were observed before moving on to the regression model.

Data Screening

To prevent the influence of partial data on the results, this study used listwise deletion, a more conservative approach to removing all cases that have missing data. Listwise deletion of missing data was appropriate for large weighted sample size (Hair et al; 1998). Missing values were checked by running the frequencies function in SPSS, as part of the process to inspect the data for completeness and accuracy. After deleting cases for missing values, the final dataset included 1302 full-time and part-time teachers whose main teaching assignment is mathematics. Following the preliminary analysis, the study used Cook's distance to identify outliers that were influential in affecting the regression coefficients. Large values of Cook's distance (usually greater than 1) indicate substantial influence by the case in affecting the estimated regression coefficients (Cook, 1977). If found, these cases were examined with caution to determine whether they should be removed from the analysis.

Selection of Items

Items were selected based on proper conceptualization and model building of the study. They were chosen to best represent the theoretical constructs of interest. Please see Table 1 for a description of the observed variables used for the study.

Recoding of Variables

In this study, some items with Likert scale responses were reversely coded so that numerical values from low to high indicated a decrease in disagreement and an increase in agreement. Specifically, the study identified seven (7) items (T0443, T0445, T0452, T0435, T0444, T0446, and T0467) of which their initial response choices ranged from strongly agree, associated with 1, to strongly disagree, and associated with 4. Those items were reversely recoded for interpretability.

Table 1. Observed Variables

	Variables	Observed variables	Descriptions
Constructs	Teacher Collaboration	Teachers share the same beliefs about school mission	T0443. Indicates the extent to which teachers agree or disagree that most of their colleagues share beliefs and values about what the central mission of their school should be.
		There is a cooperative effort among staff members	T0445.Indicates the extent to which teachers agree or disagree that there is a great deal of cooperative effort among the staff members at their school.
		Teachers coordinate content of course with each other	T0452. Indicates the extent to which teachers agree or disagree that they make a conscious effort to coordinate the content of their courses with that of other teachers
		Peer observation	T0366. Indicates whether teachers observed, or were observed by, other teachers in their classroom for at least 10 minutes in the last 12 months of taking the survey.
		Peer collaboration	T0365. Indicates whether teachers participated in regularly scheduled collaboration with other teachers on issues of instruction.
		Teachers engage in collaborative research	T0364. Indicates whether teachers engaged in individual or collaborative research on a topic of professional interest in the last 12 months of taking the survey
	Administrative Support	Teachers had regular supportive communication	T0435. Indicates the extent to which teachers agree or disagree that their school administration's behavior toward the staff is supportive and encouraging.
		The principal had communicated the kind of school desired	T0444.Indicates the extent to which teachers agree or disagree that their principal knows what kind of school he or she wants and has communicated it to the staff.
		Staffs are recognized for a job well done	T0446. Indicates the extent to which teachers agree or disagree that staff members are recognized for a job well done at their school
		School is well run	T0467. Indicates the extent to which teachers agree or disagree that they like the way things are run at their school.
	URBANS 12	School urbanicity	URBANS12. Collapsed urban-centric school locale code 1.Non-rural and 2. Rural
Dependent	Usefulness of PD on Math Reading	Usefulness of PD on reading instruction	T0346. Indicates the usefulness of the PD activities that focus on reading instruction

Predictor Variables

Teacher Collaboration

The study identified six observed variables (see Table 1) to capture the construct teacher collaboration. The first three variables (T0443, T0445, and T0452) used a 4-point scale ranging from 1= strongly agree to 4= strongly disagree. The last three items (T0364, T0365, and T0366) used the nominal scale of 0=No to 1=Yes.

Administrative Support

The study used four observed items (see Table 1) in the data to capture the predictor variable administrative support. All of them used a four-point scale ranging from 1= strongly agree to 4= strongly disagree. The study reversely recorded these items for easy interpretability.

Urbanicity

One variable defined this predictor variable: URBAN12. This variable referred as the "urban-centric" classification initiated by NCES, of all schools in four major categories: city, suburban, town, and rural. For our research questions purposes, our study considered two classifications: nonrural schools (city, suburban, and town) and rural. This variable used a binary scale of 0 = non-rural and 1= rural.

Dependent Variable

Usefulness of Professional Development on Mathematics Reading Instruction

In the SASS12 questionnaire, teachers were asked to indicate the usefulness of the professional development activities that focused on reading instruction. As the sample of study selected only teachers whose main teaching assignment was mathematics, we assumed that mathematics reading was the focus of instruction. Teachers were asked to indicate the usefulness of the professional development activities that focused on reading instruction (T0346). Their responses were measured using a four-point Likert scale, ranging from 1 = not useful to 4 = very useful.

Data Weighting

SASS 12 used a stratified probability sample design to gather information representative of the target population. For public school samples, SASS 12 developed a two-stage sampling design to stratify the sample. The first level of stratification was by type of schools and the second level of stratification varied within school type. To achieve a geographically- balanced sample within a stratum, SASS developed a technique of weighting using the unequal probabilities of selection in order to reach sufficient representation of sub-groups in the survey population. For example, because of its relative underrepresentation in the teacher workforce, SASS oversampled new teachers' data to increase its proportion among the teacher samples.

Normalized Weight

The NCES provided the final weight for public school teachers (TFNLWGT). This final weight was the product of: (a) the initial basic weight (the inverse of the probability of selection of the teacher at the time of selection); (b) a sampling adjustment factor (reflects the probability a school would be selected into the sample); (c) the teacher list nonresponse adjustment factor (accounts for schools selected who did not provide a teacher listing); (d) a teacher-within-school nonresponse adjustment factor (an adjustment for teachers selected who did not respond to the survey); (e) a first-stage ratio adjustment factor (adjusts for sampled schools' estimates to the whole school sampling frame); and (f) the teacher adjustment factor (adjusts to any inconsistencies between the school data files and teacher data files) (NCES, 2012). The weight (TFNLWGT) was normalized $\left(\frac{\text{tfnlwgt}}{\text{mean(tfnlwgt)}}\right)$, with its mean = 173.86, to adjust standard error estimates of simple random samples design effects and to get a better sense of the data itself

(Thomas & Heck, 2001). With the normalized weight applied to the sample, the sample size was reduced from 1302 to 487. Due to the clustered nature of our sample, there might exist homogeneity within clusters (schools) that would lead to an underestimation of the standard error values (Hox, 1998; Thomas and Heck, 2001). Therefore, it was recommended to use the design effect adjusted weights to account for the disproportionate sampling and cluster sampling and to ensure the most reliable estimate (Thomas and Heck, 2001). The design effect was basically the ratio of the actual variance, under the sampling method used, to the variance computed under the assumption of simple random sampling (US Census Bureau, 2001; Frongillo, 1996; Henry, 1990).

Design Effect

The NCES has stopped including design effects for SASS and TFS in its documentation materials after the release of the 1990-1991 SASS. However, in surveys such as SASS, in which a very large number of variables were measured, it was suggested to calculate the design effect for a group of similar variables and then calculated their average as a measure of the efficiency of the sampling design with respect to the group of variables (Salvucci et al., 1995). The design effect (*deff*) was calculated as follows:

$deff = 1 + \delta (n - 1)$ (1), where δ was the intraclass correlation coefficient (ICC), and n was the cluster sample sizes (i.e. teachers per school) (Johnson, 2009). With the normalized weight applied to the sample, the average number of Math teachers per school was 1.01. The average measure of the ICC of variables that represented the construct administrative support was .83. Using the formula (1), the design effect for these variables was 1.00829. The average measure of the ICC for the variables that represented the construct teacher collaboration was .72. The calculation of the design effect for these variables was 1.00719. The overall design effect of

1.00774 was obtained by averaging the two design effects. The study used the overall design effect (*deff*) to adjust the sample size by multiplying the normalized weight by $\frac{1}{deff}$. The sample size was then reduced to 452

Data Analysis

Reliability

Internal reliability was used to evaluate how strong the identified items were holding together in measuring the respective construct. A composite indicator would be created for teacher collaboration and administrative support by summing their respective items if the items showed sufficient internal reliability. To assess reliability, a Cronbach's alpha was calculated for each factor-scale. Cronbach's alpha was a function of the average intercorrelation of items and the number of items in the scale. Hair et al. (1998) suggested that reliability estimates between 0.6 and 0.7 represented the lower limit of acceptability for reliability estimates.

Regression Model

To answer the first research question, the study used a multiple regression analysis to predict teachers' perception of useful professional development on mathematics reading instruction. The predictors were the constructs teacher collaboration and administrative support. In the second research question, the study examined whether teacher collaboration and administrative support functioned differently for teachers in rural areas and their nonrural counterparts in terms of usefulness of professional development opportunities. For that, an OLS multiple regression model was performed in each level of teacher urbanicity to examine the influence of teacher collaboration and administrative support.

CHAPTER 4

RESULTS

Preliminary Analysis

Correlations and Descriptive Statistics of Variables

Descriptive statistics including means and standard deviations were calculated for all variables identified in Table 2. In addition, Pearson correlations were computed between all pairs of predictors and dependent variables. The absolute value of the correlation coefficients was less than .6, suggesting the multicollinearity of independent variable was unlikely.

Table 2: Correlations and Descriptive statistics of observed variables

Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Mean**	**Standard Deviation**
1.Usefulness of Professional Dvpt	1.000										2.47	.86
2.Supportive Communication	.125**	1.000									3.26	.85
3.Belief school mission	.227**	.271**	1.000								3.18	.70
4.Principal shared vision	.146**	.534**	.456**	1.000							3.30	.83
5.Tchr Cooperative effort	.211**	.412**	.564**	.483**	1.000						3.14	.76
6.Tchr recognition	.209**	.554**	.378**	.569**	.535**	1.000					2.96	.85
7.Tcher coordinate course content	.184**	.149**	.285**	.196**	.292**	.207**	1.000				3.36	.74
8.School well run	.199**	.596**	.367**	.515**	.514**	.517**	.242**	1.000			2.86	.88
9.Tcher collab. research	.138**	-.005	.003	.054	.028	.067	.066	.007	1.000		.47	.50
10.Peer collaboration	.150**	.079	.090	.092*	.134**	.087	.148**	.098*	.205**	1.000	.89	.32
11.Peer observation	.155**	.063	.066	.054	.105*	.098*	.035	.062	.056	.105*	.76	.43

*** p <.01; *p < .05*

Finalized Factor Structure of the Model

A reliability analysis was carried out and Cronbach's alpha showed all four items of the construct administrative support to reach acceptable reliability, α = 0.83. However, the results showed low explained variance accounted for by four items loading on the construct teacher collaboration: teachers coordinated course content with each other (0.112), peer collaboration (0.047), peer observation (0.03), and teachers engaged in collaborative research (0.01). These four items appeared to measure information that was not consistent with the dimension defined by other two items: teachers shared the same beliefs about school mission and there was a cooperative effort among staff members. In fact, the reliability statistics confirmed these results with an inadequate internal reliability (.53) of the construct teacher collaboration. The construct teacher collaboration using two items: 1) teachers shared the same belief about school mission and 2) there was a cooperative effort among staff members would have a Cronbach's alpha of .72, suggesting an adequate internal consistency. Given the support from literature review, the items teachers coordinated course content with each other, peer collaboration, peer observation, and teachers engaged in collaborative research were not deleted from the analysis. Rather, they were included in the regression model as individual independent variables. Finally, the correlation between the constructs teacher collaboration and administrative support was 0.597. This value is lower than the correlation of 0.79 (Figure 1) between the same two constructs in a confirmatory factors analysis (CFA) that was conducted to confirm the sufficient measure of the two constructs because the error components of the two constructs were removed before the correlation was calculated, whereas for the bivariate correlation of 0.597, the sums of the constituting items were used without removing any potential error components. Therefore, the two constructs teacher collaboration and administrative support were neither redundant nor having serious multicollinearity problem. The finalized factor structure was depicted in Figure 1.

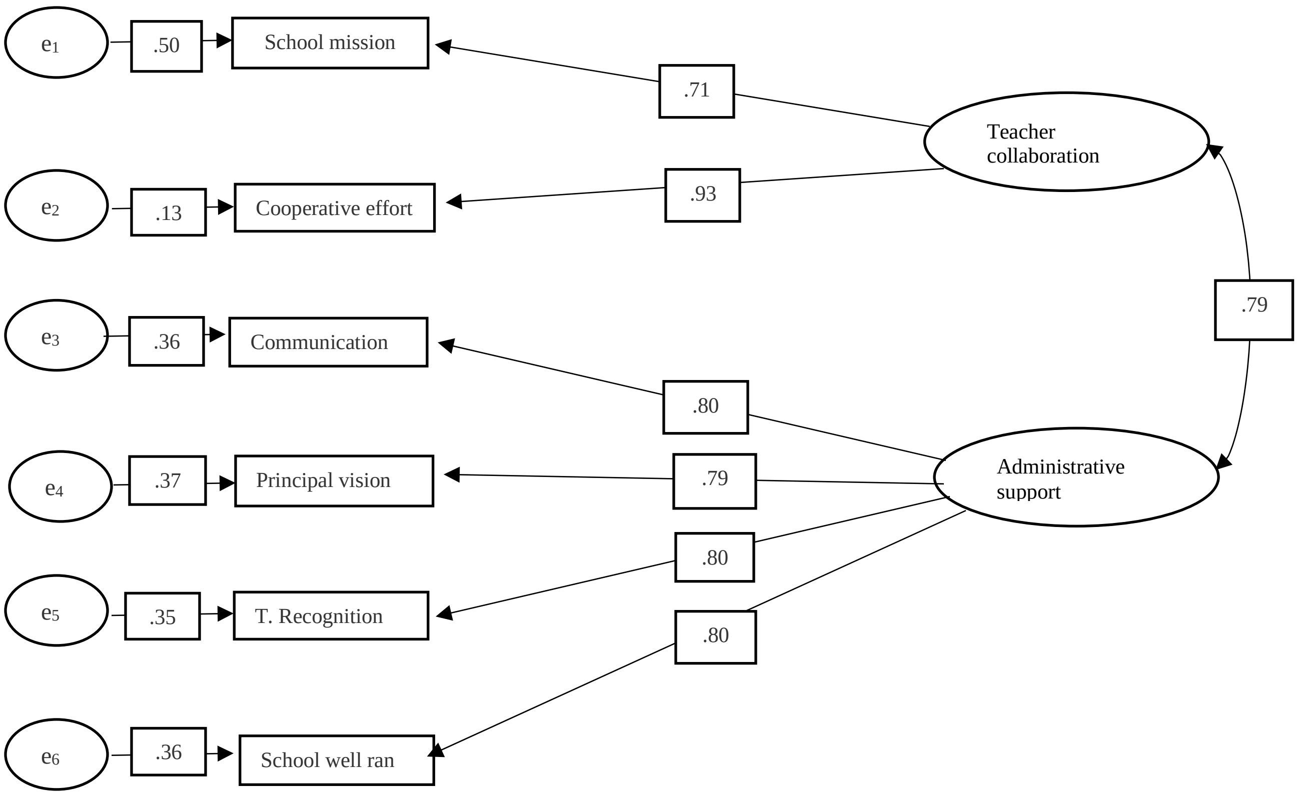
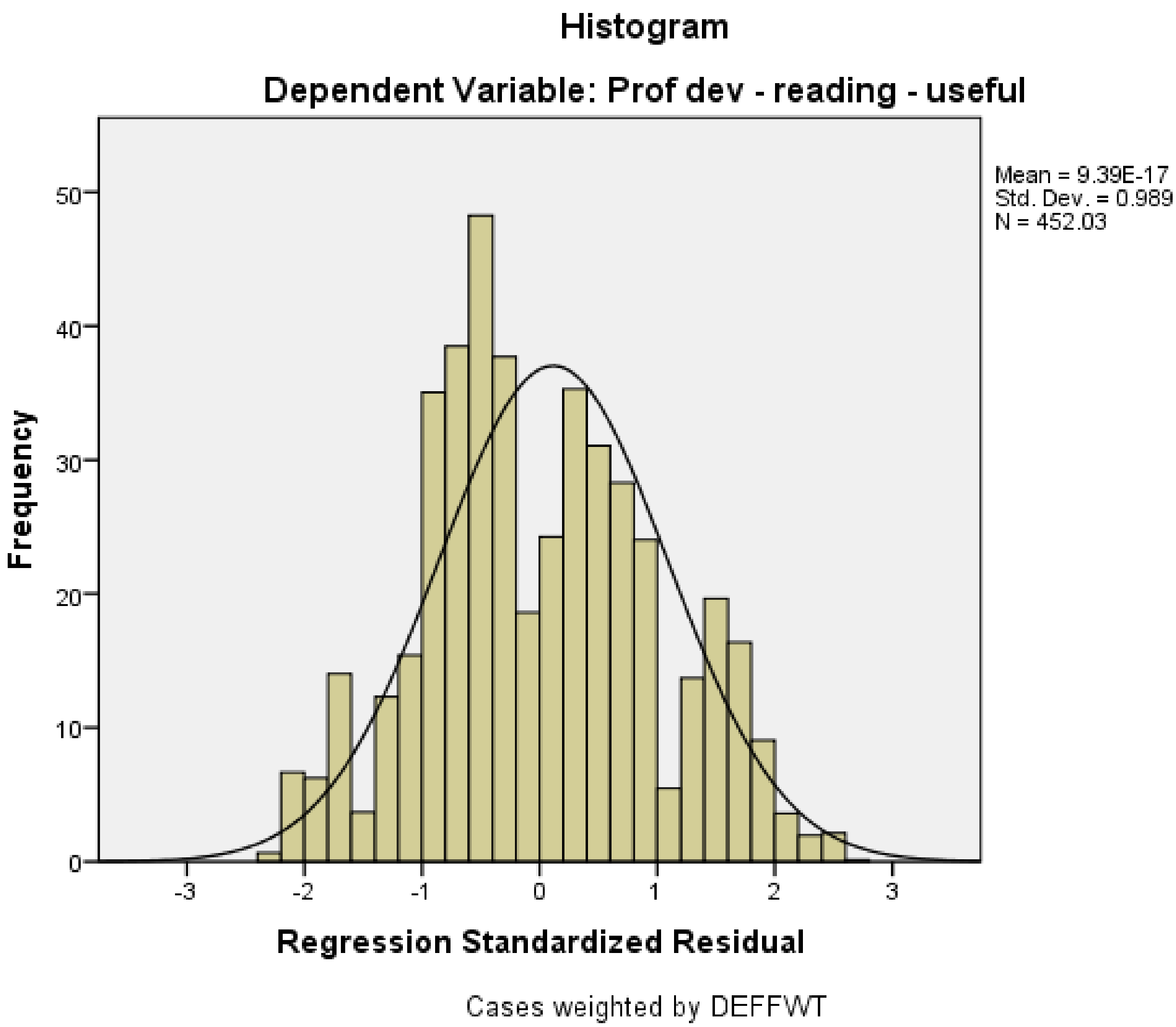


Figure 1: Finalized Factor Structure of the Model

Assumptions

Before conducting the hierarchical regression analysis, it was important to evaluate assumptions. Using SPSS 24.0, data analyses were conducted, and scatterplots exhibited linear relationships between the dependent variables and the independent variables. Analysis of collinearity statistics showed that VIF scores were well below 10 (VIF min= 1.021, VIF max=1.653), confirming an absence of multicollinearity in the model. A visualization of a histogram of the residuals of the dependent variable showed minor departure from normality (Figure 2), but violation of normality had minimal consequences when the sample size is large. No apparent problem was noticed on the plot of standardized residuals vs standardized predicted values, indicating that the assumption of homoscedasticity was met (Figure 4). No influential



outlier was detected, at each level of the dependent variable (Cook's *d* min=.000, Cook's *d* max=.036) (Figure 5).

Figure 2: Histogram of the Residual of the Dependent Variables

Figure 3: Normal P-P Plot of Regression Standardized Residual

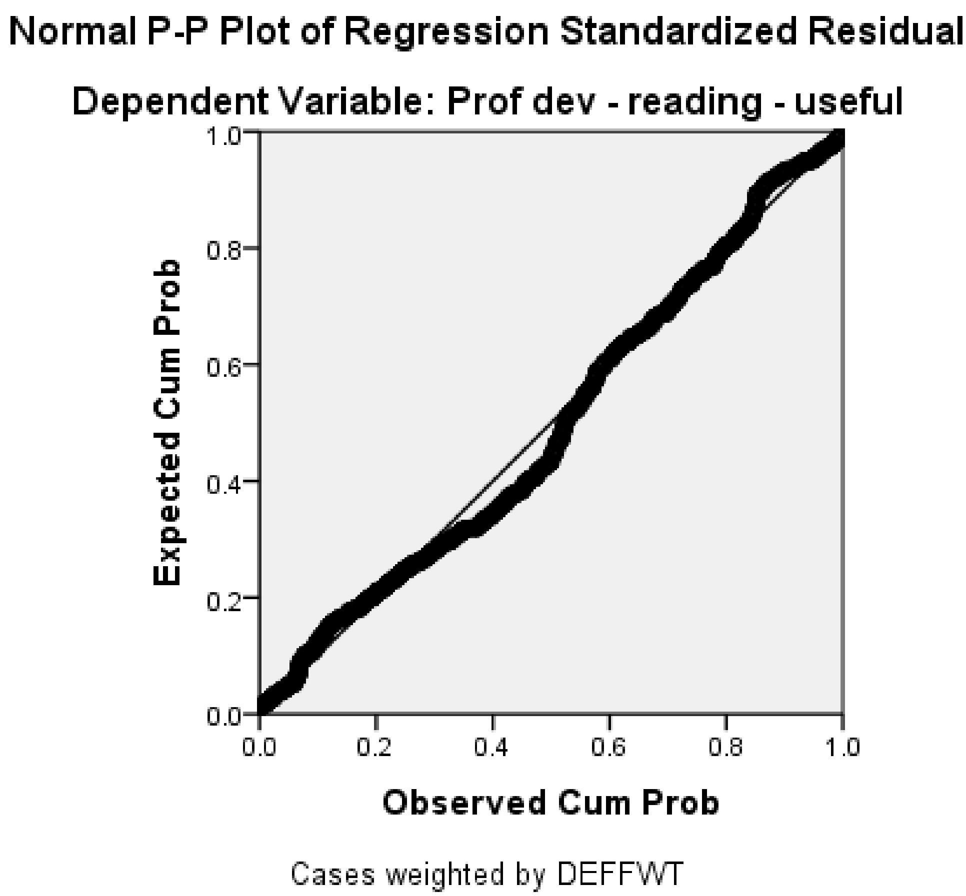


Figure 3: Normal P-P Plot of Regression Standardized Residual

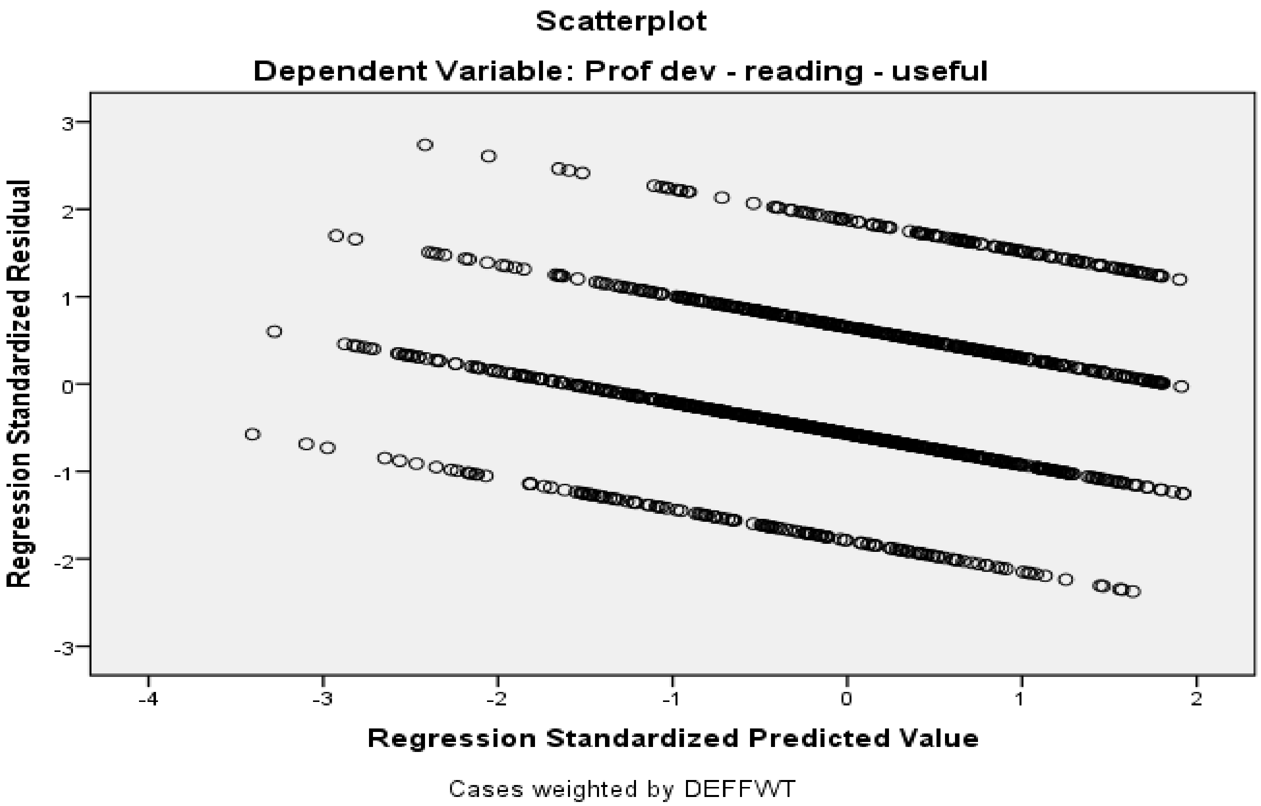


Figure 4: Plot of Standardized Residuals vs Standardized Predicted Values

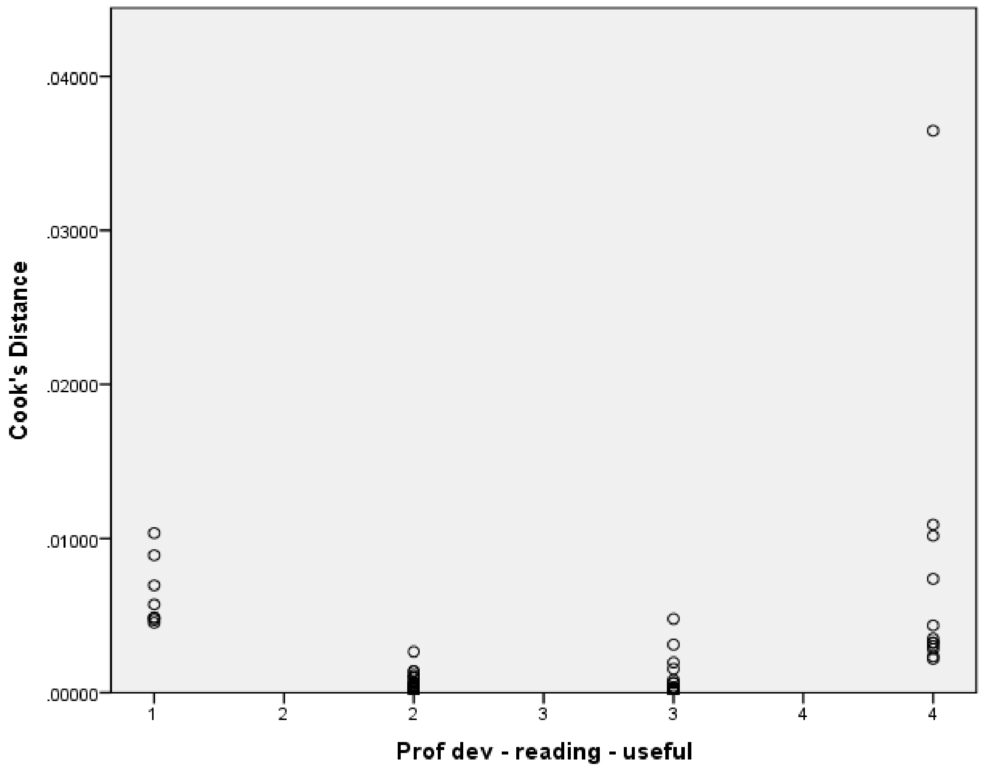


Figure 5: Scatterplot of Cook's d vs Dependent Variable

Hierarchical Multiple Regression

Prior to the analysis, a preliminary regression analysis was conducted to learn if the variable teacher teaching experience and level of education should be included as control variables. Since they were both found to be statistically non-significant, they were omitted from the final analyses. An ordinary least square (OLS) multiple regression analysis was performed to determine which identified factors were influential to teachers' perception of useful professional development on mathematics instruction. Due to the nature of the dependent variable (ordinal), OLS regression was favored because of its inherent robustness to account for this type of outcome. Moreover, OLS regression allowed our study to exert comparisons based on standardized regression coefficients.

For research question one, a hierarchical multiple regression analysis was performed to examine whether teacher collaboration and administrative support predicted teachers' perception of useful professional development on mathematics instruction. Block 1 included the independent variables that fail to lean on the construct teacher collaboration: teachers coordinated content of course with each other, teachers' peer observation, teachers' peer collaboration, and teachers engaged in collaborative research. Our constructs teacher collaboration and administrative support were entered in Block 2. The regression model R^2 indicated how much of the variance in teachers' perception of professional development on mathematics instruction was explained from each blocks of predictor variables. The results of the ANOVA and regression coefficients were found in Tables 3 and 4.

The overall hierarchical multiple regression suggested that Block 1 was statistically significant (F (4, 447) change = 9.42, $p < .001$) with 7.8 % of variance explained to the model. In model 1, teachers' coordinating course content with each other (β=.159, p <.01), teachers' peer observation (β=.134, p <.01), and teachers' collaborative research (β=.102, p <.05) were found statistically significant. Block 2 was statistically significant (F (2, 445) change = 9.06, $p < .001$) accounting for 3.6 % of the additional variance explained. Of the two variables added in Block 2, only teacher collaboration (β=.149. p<.05) was found to be statistically significant.

In model 2, four variables were significantly related to teacher perception of the usefulness of the professional development they had attended. In order of their effect size (indicated by the standardized regression coefficients), the four variables were teacher collaboration (β=.149, p<.05), teacher peer observation (β=.117, p<.05), teacher collaborative research (β=.105, p<.05), and teacher coordinating course content with each other (β=.095, p<.05).

Table 3: Hierarchical regression models – All teachers in the sample

	Model 1			Model 2		
Predictors	b	β	t	b	β	t
T. coordinate course	.184	.159**	3.454	.110	.095*	1.987
Peer collaboration	.249	.092	1.947	.204	.075	1.617
Peer observation	.270	.134**	2.929	.235	.117*	2.591
Collaborative research	.175	.102*	2.185	.180	.105*	2.291
Teacher collaboration				.099	.149*	2.600
Adm. support				.023	.075	1.340
R^2 change		.078***			.036***	

Notes: b = Unstandardized Coefficients
β = Standardized Coefficients
*** *p* < .001; ***p* < .01; **p* < .05

Table 4: Summary of ANOVA for Models of All teachers in the Sample

Model (Block)		Sum of Squares	Degrees of Freedom	Mean of Square	F
	Regression	25.953	4	6.488	9.416***
1	Residual	308.041	447	.689	
	Total	333.994	451		
	Regression	38.005	6	6.334	9.524***
2	Residual	295.989	445	.665	
	Total	333.994	451		

*** *p* < .001

In the second research question, an OLS multiple regression model was performed in each level of teacher urbanicity to examine whether teacher collaboration and administrative support functioned differently in terms of usefulness of professional development opportunities.

Unlike the initial regression, all variables were entered simultaneously, and the study compared regressions coefficient across models (Table 5).

Table 5: Regression Models-Nonrural teachers vs Rural teachers

	Nonrural Teachers			Rural Teachers		
	b	β	t	b	β	t
T. coordinate Course	.120	.104	1.871	.075	.064	.666
Collaborative research	.173	.101	1.912	.199	.113	1.214
Peer collaboration	.172	.061	1.127	.271	.108	1.154
Peer observation	.278	.134*	2.546	.146	.077	.851
Teacher collaboration	.099	.145*	2.201	.105	.167	1.393
Administrative support	.020	.060	.947	.033	.110	.923
F		6.862***			2.578*	
R Square		.111			.124	

**p* <.05; ***p* <.01; ****p* < .001

The overall multiple regression suggested that the model representing nonrural teachers was statistically significant (F (6, 328) change = 6.862, $p < .001$) with 11.1% of total variance explained by the model. Likewise, the model consisting of rural teachers was statistically significant (F (6, 109) change =2.578, $p < .05$) accounting for 12.4 % of overall variance. When the model containing only nonrural teachers was estimated, two variables were statistically related to teacher perception of professional development they attended. In order of their effect size (indicated by the standardized regression coefficients), these variables were teacher collaboration (β=.145, $p < .05$), and teacher peer observation (β=.134, $p < .05$). The adjusted R-squared value the model was .095. When the model containing only rural teachers was estimated, no predictors were found to be statistically significant, and the adjusted R-squared value was .076. With regards to the influence of teacher collaboration and administrative support, our findings showed that teacher collaboration is significant for teachers in non-rural schools but not for teachers in rural schools. However, given the higher standardized coefficient (β=.167) of teacher collaboration in rural schools and the lower sample size (N=117) compared to nonrural teachers (β=.145*, N=335), the difference between the two models may imply that teacher collaboration had substantial influence on the perceived usefulness of professional development by teachers in both rural and non-rural schools. The smaller sample size of teachers in rural schools may contribute to reduced statistical power and smaller likelihood of reaching statistical significance of teacher collaboration therein.

Discussion

Full Model with All Teachers in the Sample

Teachers with greater disposition to coordinate the content of their course with that of other teachers, to observe other teachers in their classroom, to engage in individual or collective research on a topic of professional interest, and to collaborate with other teachers had higher perception of professional development they attended. Nonetheless, teachers with greater disposition to collaborate with others had much greater magnitude than the rest of them. Using the unstandardized coefficient, the study estimated that a unit change in teacher collaboration produced .099 change in teachers' perception of useful professional development. In terms of effect size, this coefficient represented about .11 standard deviation increase in teacher's perception of useful professional development. Effect sizes are represented by the standardized regression coefficient, which was determined by dividing the coefficient by the standard deviation of the dependent variable. This study sought to determine the importance of teacher collaboration in relation to useful professional development. Others have documented that school attaining higher levels of collaboration extend teachers' collaboration with peers beyond formal teaming structures (Tait-McMutcheon & Drake, 2016; Moller et al., 2013). Our results supported this idea and suggested that teacher collaboration was more predictive of teacher's perception of useful professional development when teachers shared beliefs and values about what the central mission of their school should be and when there was a great deal of cooperative effort among the staff members at their school. The variable Administrative support was not statistically significant in any of the models of the study. At odds with what has been hypothesized, administrative support had no influence in teachers' perception of useful professional development. We knew from previous work that administrative support was expected to provide incentives and opportunities for teachers to grow (Phillips et al., 2011). Our finding raised questions on how administrative support should be shaped to be a significant contributor of teachers' perception of useful professional development. In our analysis, administrative support was shaped by consideration of leadership (school is well run, and staffs are recognized for a job well done), and communication (teachers had regular supportive communication and principal had communicated the kind of school desired). Our analysis did not include concepts previous research had shown, beside communication, teachers paid the most attention: inclusion, empathy and initiative (Van Huizen et al., 2005; Alvoid & Black, 2014).

Teachers with greater disposition to coordinate the content of their course with that of other teachers was found to be statistically significant to teachers' perception of useful professional development. That was, a unit change in that variable produced .110 change in teachers' perception of useful professional development. This coefficient represented about 0.130 standard deviation increase in teachers' perception of useful professional development.

Research on teacher professional development has pointed out heavy investment of district policy to the quality and configuration of teachers' social network (Rivera et al., 2010, Coburn et al., 2013). These networks brought teachers together as they shared the content of their course with that of other, shared valuable information, and engaged in joint problem solving.

Teacher peer observation was found to be statistically significant. A unit change in teacher peer observation produced .235 change in teachers' perception of useful professional development. This coefficient represented about .273 standard deviation increase in teachers' perception of useful professional development. Consistent with our literature review, teacher peer observation was viewed as one the most reflective practice in shaping teachers' pedagogy and professional competences (Kahl et al., 2013; Fatemipour, 2013; Susoy, 2015; Soisangwarn & Wongwanich, 2014). Teachers who had greater disposition to engage in individual or collective research on a topic of professional interest had higher perception of professional development they attended. Using the unstandardized coefficient, the study estimated that a unit change in that variable produced .181 change in teachers' perception of useful professional development. In terms of effect size, this coefficient represented about .210 standard deviation increase in teacher's perception of useful professional development. This result, quite encouraging, had corroborated recent national surveys' report of an emerging paradigm of teacher collaborative research to improve teacher professional development (Darling-Hammond et al., 2017; Tait-McCutheon & Drake, 2016).

Teacher Urbanicity: Nonrural vs Rural

The sample of study was composed of 335 nonrural teachers and 117 rural teachers. Our finding suggested that teacher collaboration was influential to nonrural teachers' perception of useful professional development. Using the unstandardized coefficient, our results suggested that a unit change in teacher collaboration produced .099 change in teachers' perception of useful professional development. In terms of effect size, this coefficient represented about .12 standard deviation increase in teacher's perception of useful professional development. This was consistent with previous work that highlighted heavy investment in teacher human capital development, in nonrural schools, specially through a school-based team approach. Research illustrated quite strongly this approach embedded in an integrated professional culture designated to bring teachers together to share best practices and develop content knowledge and pedagogical skills (Wubbels et al., 2012; Garet et al., 2001; Watlington and al., 2010). As opposed to rural teachers, our results reported that teacher collaboration was not significantly related to teachers' perception of useful professional development. Beside the fact that rural schools in general, operated in less formal modes than it nonrural counterparts, professional isolation is a prominent issue teacher collaboration faced in rural areas. Professional isolation created little access to experienced teachers who can support teachers in their subject areas (Jenkins, Reitano, & Taylor, 2011). The resulting sense of isolation increased teachers' pressure as sharing resources with others was very limited or inexistent.

Our results suggested teacher peer observation in nonrural schools greatly influenced teachers' perception regarding their professional development they attended. That is, a unit change in peer observation produced .134 change in teachers' perception of useful professional development. This coefficient represented .16 standard deviation increase in teachers' perception of useful professional development. This finding was supported by effective mentoring and induction programs in nonrural schools, which research has illustrated quite strongly that individual teachers contributed measurable difference to other teachers' growth (Kahl et al., 2013; Hammersley-Fletcher & Orsmond, 2005).

In the leadership dimension, our results suggested that administrative support was not found to be statistically significant both in rural and nonrural schools. This finding would raise an important question for educators and policymakers: What help do these school leaders need to develop the know-how to plan professional development that have evidence of effectiveness? Today's nonrural school leaders deal with building a positive school culture. Growing volume of research had reported that administrative support measured by trust and high willingness were the most important supports, whereas administrators thought frequent interaction with teachers were more important (May & Supovitz, 2011; Hicks, 2011, Cornella, 2010; Blase & Kirby, 2009; Hernandez, 2006; Useem, 2001). Therefore, it was important for school leaders to establish an atmosphere of trust and mutual respect among teachers, as it served as a foundation for a successful organization. Consistent with the literature review, school leaders in rural areas struggled to invest in the provision of effective teacher support (Renihan & Nooman, 2012). Preston et al. (2013) pointed out the poor access to high-quality professional development to rural principals relevant to coherent policies and protocols for teachers to grow. Moreover, rural principals assumed a wide variety of simultaneous duties to cover low staffing issues, which reduced considerably the amount of time delegated to set formal accountability procedures and goals for teachers' outcomes (Parson, Hunter, & Kallio, 2016; Renihan & Nooman, 2012). Given the important role that principals were expected to play to guide a school's improvement process, rural principal's constant churn and lower levels of stability had made it difficult for any commitment to support teachers' growth (Miller, 2013). Jacob et al. (2014) studied the relationship between principal professional development and turnover on a sample of 122 principals in rural Michigan. They found that principals' turnover significantly decreased among those who participated in the professional development.

Limitations, Implications for Practice and Future Research

Due to data limitations, this study fails to cover many variables that were relevant to the usefulness of professional development. These variables included, but not limited to, alignment of professional development to standards- based reforms (standards and assessments), coherence and consistency of state and local policies toward implementing mathematics reforms. Thorough implementation of these policies changed teachers' attitudes toward learning and motivated them to pursue learning experiences through professional development (Phillips et al, 2011). Further research is needed to examine to what extend these variables influence teachers' prediction of professional development.

Another limitation resided from the fact there appears to be a lack of clear and empirical insight into the characteristics of useful professional development. The SASS 12 data were based upon teacher self-reported information. Teachers' perception of usefulness of professional development was contingent to some degree, such as teacher individual background, individual and professional needs, expectations, characteristics of professional development structures, the dynamics of teacher teamwork, and the school-level collaboration. Although our study provided evidence that teacher collaboration predicted their perceptions of useful of professional development, it did not address the collaboration content, comprehensive models that bring teachers to collaborate in teams, a potential measure of a value of school-level collaboration. It would be interesting for future research to perform an exploratory empirical study using those measures and to what extent they actually change from teams in other schools.

A very common question was whether it was legitimate to use Likert scale data in linear measured as the difference in the mean of the likert scale outcome, for each one-unit difference in the predictor. One would question the meaningfulness of a one-unit difference referring to switching from one category to the other (i.e., if a one-unit change from strongly disagree (1) to disagree (2) was roughly equivalent to a one-unit change from disagree (2) to agree (3)). Future research is suggested using ordinal logistic regression to predict ordinal placement in the dependent variable teachers' perception of useful of professional development. Fortunately, logistic regression is formulated without relying on the strict existence of the required assumptions for multiple regression analysis (e.g., linearity, independence, etc.). In reporting the results, emphasis is placed upon the odds ratio, the multiplicative analogue of the unstandardized coefficient in linear regression (DeMaris, 2004). It reflects the multiplicative change in the dependent variable as a result of a unit change in the predictor variable.

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