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# Mathematical Instructional Practices and Self-Efficacy of Kindergarten Teachers

Tammy Schillinger
*Walden University*

# Walden University

COLLEGE OF EDUCATION

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Tammy Schillinger

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Dr. Donald Yarosz, Committee Member, Education Faculty
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Chief Academic Officer

Eric Riedel, Ph.D.

Walden University
2016

Abstract

Mathematical Instructional Practices and Self-Efficacy of Kindergarten Teachers

by

Tammy Schillinger

MA, The College of St. Rose, 2001

BS, University of Albany, 1999

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

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## Abstract

A local urban school district recently reported that 86% of third graders did not demonstrate proficiency on the Math Standardized Test, which challenges students to solve problems and justify solutions. It is beneficial if these skills are developed prior to third grade. Students may be more academically successful if kindergarten teachers have moderate to high self-efficacy when teaching lessons that focus on justifying solutions. Bandura's self-efficacy theory was incorporated into this study as the conceptual framework lens. Research questions were designed to investigate kindergarten teachers' instruction in mathematics that focused on justifying solutions, their self-efficacy in challenging students to justify solutions, and the identification of professional development. Voluntary participants for this study were selected from the 11 elementary schools in the district. Within the 11 elementary schools, there were 33 lead teachers who were invited to participate in the study and 7 agreed to participate in interviews and observations. The data were analyzed using both situation and strategy coding. The analysis of the data revealed a connection between professional development, self-efficacy, and instructional strategies. A relationship was identified between professional development and the teachers' ability to challenge students to problem solve and justify solutions. These findings may be valuable for early childhood stakeholders within the education field. Professional development tends to improve the self-efficacy of teachers and the instructional strategies they incorporate.

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# Dedication

This doctoral journey has been unlike any journey I have encountered. Throughout this journey two people have guided me, supported me and inspired me to be excellent! During challenging times these amazing people would be there to encourage me to move forward and focus on my goal. This is dedicated to my husband Thomas Schillinger who supported me throughout this journey and my daughter Olana Schillinger who reminded me to always take a deep breath. Thank You!

# Acknowledgments

The completion of this journey has been possible because I had so many amazing people who guided me throughout this process. I would first like to express my greatest appreciation for my family who encouraged and motivated me during this journey. I would like to thank my husband who supported me in so many ways and kept me motivated to accomplish my goals. I would like to thank my daughter Olana. Her excitement of learning has been encouraging and inspiring. I would like to thank my mother-in-law and father-in-law for always inquiring about the process and being excited as I completed each stage of the doctoral process.

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I would like to express my appreciation for the teachers in the local school district who allowed me to interview and observe them in their classroom. Their willingness to discuss and share information on this topic provided valuable insight into the world of teaching.

This dissertation would not be possible without these wonderful people.

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Section 1: Introduction to the Study

## Introduction

Elementary math is no longer memorizing math facts, computation and rote learning. Since the adoption of the Common Core State Standards in 2010 by New York State Education Department, students as early as prekindergarten are expected to develop an in-depth understanding of mathematical concepts, develop problem solving strategies, justify their solutions, and understand the underlying concepts behind mathematical ideas (Mongeau, 2014). All of these skills are considered critical thinking skills or higher order thinking (Mongeau, 2014).

The Partnership for the 21st Century Skills (2014) defines critical thinking as problem solving, synthesizing, and making connections to information. According to Lai (2011), critical thinking involves problem solving, higher order thinking, language development, and analytical skills. Critical thinking has also been defined as exploring problems to arrive at a solution, and justifying the solution (Warnick & Inch, 2009). For the purpose of this study, critical thinking skills were defined as problem solving and justifying the solution (Lai, 2011). For example, the prekindergarten and kindergarten Common Core math standards adopted by New York State include making sense of problems, persevering in solving them, and reasoning abstractly (EngageNY, 2015). Further, mathematical understanding is the ability to justify why a mathematical statement is true or false (EngageNY, 2015).

The NCTM (2011) believes that cognitively challenging tasks should be taught in a manner that challenges students' minds. High expectations should be emphasized for all students from prekindergarten to college (NCTM, 2011). These high expectations should be applied in the

areas of complex mathematical concepts and the engagement in mathematical reasoning and problem solving (NCTM, 2011). Furthermore, the National Association for the Education of Young Children (NAEYC), and the National Association of Early Childhood Specialists in State Departments of Education strongly suggest that early childhood education focus on challenging and engaging curriculum (NCTM, 2013). Within this curriculum, early childhood students should be encouraged to explain their thought process as they engage in mathematical concepts and develop a deep understanding of these concepts (NCTM, 2013). Effective instruction in mathematical concepts requires that the teacher have confidence in their own ability to foster an in-depth level of understanding in their students.

As a college professor, I conducted a needs assessment in a local urban school in 2014. This assessment was conducted with two prekindergarten teachers and two kindergarten teachers. The prekindergarten and kindergarten teachers who were interviewed reported that they lack the ability to teach critical thinking skills to young children. The conversations conducted in the assessment identified that these teachers had low confidence in implementing strategies needed to instruct students in math and critical thinking skills. Three of the four teachers admitted that they had low confidence in teaching mathematical concepts and did not have the strategies to teach critical thinking skills. Since there was some evidence of a problem with respect to teachers' self-efficacy in teaching math and critical thinking skills, there is a need to explore this issue further to determine if it is more widespread.

Inquiry into current research regarding self-efficacy in teaching math and critical thinking skills revealed that the teachers in the local urban school district are not alone with respects to level of self-efficacy. There is a plethora of research that exists separately on the topics of critical

thinking skills (Case, 2005; Lai, 2011; Moore & Stanley, 2010; Torre, Doctors, Hussain, Mulkey, Wat, & Young, 2011) and teachers' self-efficacy in teaching math (Bates, Latham & Kim, 2013; Chen & McCray, 2013; Gresham, 2008; Johnson & VanderSandt, 2011; Soodak, & Podell, 1996). This study brought together the concepts of teachers' self-efficacy in teaching math and critical thinking skills. The study accomplished this by examining how teachers' instruction in mathematics challenges students to solve problems and justify their solutions.

## Problem Statement

A local problem was identified in the Albany school district in upstate New York. The Albany school district has shown no improvement in the NYS Standardized Math Test over the past few years (NYS Education Department, 2014). In fact, over the past few years the students who were performing below the proficient level are at the highest they have been in the past ten years (Table 1). Since the adoption of the Common Core Standards in 2010, there has been a negative trend in scores over the past five years. The decline in math proficiency encouraged the school district to engage in a comprehensive strategic planning process. As of February 2014, the strategic plan 2020 vision was implemented in the Albany school district. The 2020 vision plan will focus on *all* students actively engaging in high academic rigor in hopes to improve test scores on the Math Standardized test. The recent results for the school district in Albany, New York reported that 86% of third-grade students did not demonstrate proficiency on the New York State (NYS) math standardized test, which challenges students to solve problems and justify their solutions (New York State Education Department, 2014).

Table 1

*Third Grade Math NYS Test Performance in Albany, NY School District*

| Year | Math NYS Test Performance- % Not Proficient |
|---|---|
| 2014 | 86.0 |
| 2013 | 80.3 |
| 2012 | 62.7 |
| 2011 | 59.0 |
| 2010 | 52.4 |
| 2009 | 18.1 |
| 2008 | 26.5 |
| 2007 | 35.2 |
| 2006 | 36.3 |

*Note*. From NYSED. (2014). English language arts (ELA) and mathematic assessment results. Retrieved from http://www.p12.nysed.gov/irs/ela-math/Archive.html

Studies reported that developing critical thinking skills during early years of schooling may be more effective than attempting to foster these skills in the later years of elementary school (Epstein, 2008; Lai, 2011; Schiller, 2010). In their first six years, children should be encouraged to explore mathematical concepts, explain their thought process, and develop a deep understanding of mathematics (Clements & Conference Working Group, 2004). More importantly, developing critical thinking skills in mathematics is a predictor of later school success (Clements, Baroody, & Samara, 2013b).

Since the educational focus of academic rigor is on all students teachers will need to understand the methods and techniques needed to teach mathematics on this elevated academic level. This new strategy demands that instruction must incorporate high academic rigor. Rigor is used in policy discussions but it is not clearly defined and usually just means better (Gojak, 2013). After several conversations with math coaches, the NCTM president developed a chart that defined learning experiences involving rigor. Some of these experiences include a focus on

rich tasks, providing logical connections among mathematical concepts, and encouraging reasoning and flexible thinking (Gojak, 2013). The Albany school district (2014) has clearly defined high academic rigor as having elevated levels of academic engagement (Albany school district, 2014). For example, students who have the ability to *explain* numerical problems demonstrate a higher cognitive ability than students who can simply memorize numerical problems (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). One perspective on academic rigor includes instruction that fosters students' critical thinking skills (Paige, Sizemore & Neace, 2013). According to Tomlinson (2003), the integration of critical thinking skills was vital for achieving academic rigor. In order for students to participate in rigorous curriculum, teachers are expected to be competent, confident, and provide highly effective instruction in mathematics (Albany school district, 2015). The literature indicates that early childhood teachers have low self-efficacy in teaching math (Bates, Latham & Kim, 2013; Chen & McCray, 2013; Haciomeroglu, 2013; Incikabi, 2013; Johnson & Vandersandt, 2011). This indication was supported at the local level as demonstrated by the needs assessment conducted in the Albany school district. Teachers' self-efficacy impacts how they approach teaching and approach student learning. Teachers with high self-efficacy approach teaching in an optimistic manner, provide opportunities of in-depth learning, and focus on the academic needs of the students (Bandura, 1997). Teachers with low self-efficacy approach teaching in a negative manner and give up on students (Bandura, 1997).

If the prekindergarten and kindergarten teachers' self-efficacy is low in relation to teaching lessons that focus on math content with an integration of critical thinking, then students

may not be academically successful. According to Ashton (1984), teachers' knowledge and instructional approaches have the greatest impact on student performance and achievement.

## Nature of the Study

This qualitative case study included seven early childhood teachers in a local urban school district in Albany, New York. Purposeful sampling was used to select prekindergarten and kindergarten teachers. The purposeful sampling method was chosen as the most appropriate because it enables the researcher to explore, understand, and garner an in depth insight about the cases being studied (Patton, 2014). Purposeful random sampling was used to randomize the sample if more than 8 teachers are interested in participating in the study (Lodico, Spaulding, & Voegtle, 2010). The data collection instruments for this qualitative study were interviews and observations of prekindergarten and kindergarten teachers, as well as documents such as lesson plans. The data collected from these instruments were qualitatively analyzed to investigate prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions.

## Research Questions

The research questions that guided this study were:

1. What instruction in mathematics is currently used in the Albany city school district prekindergarten and kindergarten classrooms that challenge students to solve problems and justify their solutions?
2. What is prekindergarten and kindergarten teachers' self-efficacy in their ability to challenge students to solve problems and justify their solutions?

3. What professional development workshops do prekindergarten and kindergarten teachers find most effective in supporting their self-efficacy in teaching mathematics that challenge students to solve problems and justify their solutions?

## Purpose of the Study

The purpose of this study was to investigate prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions. Considering that the Common Core Standards are aligned with the state standardized tests (EngageNY, 2015), it is important for prekindergarten and kindergarten students to develop critical thinking skills. Critical thinking skills support academic success throughout elementary school and should provide the foundation needed for success on state standardized testing. Prekindergarten and kindergarten students are expected to solve problems, reason abstractly, and explain numerical problems (EngageNY, 2015). More specifically, prekindergarten and kindergarten students are expected to develop a conceptual understanding of key mathematical concepts and justify why these mathematical concepts are true or false (EngageNY, 2015). The literature supports the position that the window of opportunity to develop these skills is within the early years of schooling (Schiller, 2010). If prekindergarten and kindergarten children are challenged to think critically, then they will develop these skills, retain these skills, perform better on state tests, and be college and career ready (Lai, 2011). This research helped address the local problem by developing an understanding of teachers' self-efficacy in their instruction in mathematics that challenge students to solve problems and justify their solutions. This understanding created an opportunity for improvement on state standardized tests and may help prepare students for greater academic success.

## Conceptual Framework

The aim of my study was to investigate prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenge students to solve problems and justify their solutions. According to Bandura (1997), the "task of creating learning environments that are conducive of development of cognitive competencies rests heavily on the talents and self-efficacy of teachers" (p. 240). Therefore, teachers' self-efficacy has an impact on how they approach teaching and student learning. Teachers with high self-efficacy approach teaching in a positive manner, present opportunities of in-depth learning, and focus on the academic needs of the students (Bandura, 1997). Teachers with low self-efficacy approach teaching in a negative manner and give up on students (Bandura, 1997). More importantly, perceived self-efficacy relates to what a person believes they can accomplish and the number of skills they have attained (Bandura, 1997). According to Ashton (1984), the sense of self-efficacy is what teachers believe their abilities are to impact student achievement. Self-efficacy theory (Bandura, 1997) was used to examine the prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions.

## Operational Definitions

This study incorporates conceptual points and educational strategies within the learning process of prekindergarten and kindergarten children. The following operational definitions define specific terms within the context and scope of this study.

*Common Core Standards: "*A set of high quality academic standards in math and English Language Arts/Literacy. These learning goals outline what a student should know and be able to do at the end of each grade" (Common Core State Standards Initiative, 2015).

*Critical Thinking Skills:* The "intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action" (Critical Thinking Community, 1994). The definition of critical thinking skills has been further refined to incorporate the concepts of problem solving and justifying solutions (EngageNY, 2015; Warnick, 2009).

*Early Childhood Educators (ECE):* Generally ECE encompasses birth through age 8 (NAEYC, 2010).

*Rigor:* Elevated levels of academic engagement and the use of critical thinking skills (Albany school district, 2014; Paige, Sizemore & Neace, 2013).

*Self-Efficacy:* Beliefs that influence the courses of action people choose to pursue, how much effort they put forth in given endeavors, and how long they will persevere in the face of obstacles and failures (Bandura, 1997).

## Assumptions, Limitations, Scope, and Delimitations

### Assumptions

I made the following assumptions:

1. The teachers who participated in the study answered interview questions to the best of their knowledge by answering honestly and accurately.
2. The teachers who participated in the study were representative of the school district.
3. The documents provided by the teachers were an accurate description of their lessons.
4. Teachers did not base their answers on a perceived level of self-efficacy.
5. The math lesson observations were reflective of daily practices.

**Limitations**

The following were limitations of the study:

1. The results cannot be generalized to the larger population due to the small sample size.
2. The data collection was limited to the Albany school district.

**Scope and Delimitations**

This study took place in the Albany school district in New York. Although there are 12 elementary schools within the school district, only 11 elementary schools were included in the study due to my relationship with one of the schools. There are five prekindergarten teachers and 33 kindergarten teachers. An invitation letter was sent to the 38 teachers in the Albany school district asking for prekindergarten and kindergarten teachers to participate in the study. If more prekindergarten and kindergarten teachers were willing to participate, purposeful random sampling was used to randomize the sample (Lodico, Spaulding & Voegtle, 2010). Prekindergarten and kindergarten teachers were interviewed and were observed during their instruction in mathematics. During the interviews and observations the focus was on teachers' self-efficacy in providing instruction in mathematics that challenges students to solve problems and justify their solutions. During the observations, the focus was on prekindergarten and kindergarten teachers' instruction in mathematics that challenges students to solve problems and justify their solutions.

During the observations I looked for evidence of students working through a mathematical problem and the support that the teachers provided for their students during this process. Documents such as math lesson plans were collected in order to explore the content of the math activities that focus on problem solving and justifying solutions. During the interviews,

observations, and analysis of the lesson plans, I focused on how prekindergarten and kindergarten teachers support students as they explore mathematical problems to arrive at a solution.

## Significance of the Study

The Common Core Standards have received criticism from early childhood stakeholders. This criticism has stated that these standards are not appropriate for young children and that the math standards are too challenging for young children (National Institute for Early Education Research, 2015). However, these are not the beliefs of all early childhood stakeholders. The NCTM and NAEYC (2010) believe that young children from ages 3-6 years old are ready to develop mathematical concepts. In the early years of development, young children notice and explore mathematical concepts that support a foundation for academic success (NCTM & NAEYC, 2010). According to Abrami et al (2008), young children are able to develop problem-solving skills when they are taught to analyze problems and justify their answers. The Common Core has become an integral part of the educational process within the Albany school district. Moreover, New York state has maintained the administration of the New York State math standardized test. It is important that early childhood educators are confident in teaching mathematics that challenge students to solve problems and justify their solutions.

My research promoted positive social change by developing an understanding of early childhood educators' self-efficacy in regards to their instruction in mathematics that challenges students to solve problems and justify their solutions. The determination of prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions can guide further studies. Further research may be

conducted in other parts of the state based on the outcome of this study. This study provided valuable information that will lead to meaningful professional learning opportunities for teachers in the local school district and abroad. In understanding teachers' self-efficacy in regards to their instruction in mathematics that challenges students to solve problems and justify their solutions, early childhood stakeholders can focus on meeting the instructional needs of the teachers. If the needs of the teachers are met, then their prekindergarten and kindergarten students may develop mathematical skills and critical thinking skills needed for academic success (Lai, 2011).

In conclusion, 86% of the students in Albany school district are performing below proficient on the 3rd grade NYS Math standardized Test, which challenge students to solve problems and justify their solutions. Third grade may be to late to teach critical thinking skills; therefore these skills must be taught in the early years of schooling. If early childhood educators are proactive and have the ability to teach math that challenges students to solve problems and justify their solutions in the foundation years of schooling, then students could perform well on the standardized tests (Moore & Stanley, 2010). According to Bouchard et al. (2010), if young children are exposed to critical thinking skills, then they will develop these skills, retain these skills, perform better on state tests, and be college and career ready. Furthermore, early childhood stakeholders could design professional development programs that focus on workshops to specifically teach early childhood educators how to effectively teach math lessons that challenge students to solve problems and justify their solutions.

## Summary

The focus of this research was prekindergarten and kindergarten teachers' self-efficacy in regards to their instruction in mathematics that challenges students to solve problems and justify

their solutions. Data was collected in Albany school district through math lesson plans, observations of teachers' instruction in mathematics, and interviews with the kindergarten teachers. The research questions developed looked at components of instruction in mathematics, prekindergarten and kindergarten teachers' self-efficacy, and effective professional development. Section 2 includes a review of the literature on (a) critical thinking skills, (b) self-efficacy, (c) professional development, (d) mathematics reform, (e) mathematics in early childhood, (f) state standardized testing, (g) common core, (h) teachers' self-efficacy in teaching math, and (i) the conceptual framework. Section 3 includes the methodology with a discussion about the design of the study, the data collection, and data analysis. Section 4 presents the data collection, the findings, and a discussion on the accuracy of the data. Section 5 includes the interpretations of the findings, the implications for social change, recommendation for action, and recommendation for further study.

Section 2: Literature Review

## Introduction

This literature review includes the conceptual framework for the study, definitions of self-efficacy and teacher efficacy, and studies concerning teachers' self-efficacy in teaching math. Following this, the topics of mathematics reform, state standardized testing, common core, and instruction in mathematical strategies in early childhood is discussed. This literature review concludes with the topics of critical thinking skills, professional development, and the methodologies. The portion involving methodologies is further narrowed into the topics of case study, interviews, and observations.

The conceptual framework section describes the theory that provided a lens for the study. The self-efficacy section is composed of a brief discussion about Bandura's (1977, 1986, 2000) analyses of high self-efficacy and low self-efficacy. The next section contains a review on teacher self-efficacy, which includes how a teacher's self-efficacy can either have a negative or positive impact on student achievement. Teacher's self-efficacy in teaching math is discussed and contains research on pre-service and experienced teachers' self-efficacy in teaching mathematical concepts. The literature consists of both qualitative and quantitative studies that discussed how low self-efficacy could have a negative impact on student achievement. Also included in the literature is the anxiety and fear teachers feel about teaching math. The mathematics reform, standardized testing, and the common core section provides an overview of how the instruction of mathematics has changed over the past few decades and how testing and the common core standards are an integral component of the education system.

The overview of critical thinking skills includes the definition of critical thinking skills. Further, the overview includes the importance of teaching critical thinking skills in the early years of development. Following the overview of critical thinking, professional development is discussed and includes the importance of early childhood educators participating in effective workshops that focus on preparing students for the 21st century.

The final section of this review focuses on the methodologies of this study. Several resources were used to develop this section including research conducted by Creswell (2013), Merriam (1998), Lodico, Spaulding & Voegtle (2010), Patton (2014), and Maxwell (2012). Case studies, interviews and observations are also discussed in this section.

**Literature Search Strategy**

The literature review involved a process of sourcing high quality and peer reviewed academic material. This review was conducted in a systematic manner in order to retrieve the most relevant and current research while covering a broad array of databases and academic sources. The databases used during this review included ERIC, ProQuest Central, Education Research Complete, SAGE Premier, Academic Search Complete, Thoreau, and Google Scholar. These databases were initially searched without date restriction in order to capture the foundational research on each of the subject areas. Later in the review process a date restriction of the previous five years was incorporated in order to focus attention on the most current research. Each of these searches were refined to seek peer reviewed journal articles and were conducted using a variety of key phrases including: (a) *self-efficacy,* (b) *self-efficacy theory, teacher's self-efficacy,* (c) *Bandura, teaching mathematics,* (d) *mathematics reform,*

(e) *standardized testing,* (f) *common core,* (g) *mathematical instructional strategies,* (h) *critical thinking,* (i) *critical thinking skills,* and (j) *professional development in early childhood education*. These terms were used in a variety of combinations in order to capture as much material as possible. The articles were reviewed for relevancy and reliability and many of the sourced articles were discarded as nonrelevant. The references of the articles that were retained were reviewed for potential peer-reviewed articles that may have been missed during the database searches.

In addition to database searches the websites of several professional and governmental organizations were also used. These organizations included: (a) Albany New York school district, the Critical Thinking Community, (b) Education First, Engage NY, (c) the National Association for the Education of Young Children, (d) National Association for Early Childhood Specialists in State Departments of Education, (e) National Council of Teachers of Mathematics, (f) National Governor's Association, (g) National Institute for Early Education Research, (h) New York State Education Department, (i) Organisation for Economic Co-operation and (j) Development and the Partnership for the 21st Century. Each of these organizations offers unique perspectives that are collectively valuable to the aims of this research.

## Review of Conceptual Framework

Bandura's (1977) self-efficacy theory was the conceptual framework lens of this study. Bandura (1977) discussed self-efficacy as a concept in investigating changes based on avoidant and fearful behavior. Ashton (1984) expanded on self-efficacy theory to include teachers' beliefs about their own abilities and how they impact student achievement. In 1997, Bandura more clearly defined self-efficacy as referring "to beliefs in ones' capabilities to organize and execute

the courses of action required to produce given attainments" (p. 3). Bandura (1997) referred to self-efficacy as ones beliefs in influencing actions and efforts one chooses to pursue. Further, Bandura (1997) explained self-efficacy in relation to how one would manage failures and obstacles. Tschanned-Moran and Hoy (2001) continued the development of this theory by discussing teacher efficacy as a judgment made by teachers concerning their own abilities to ensure positive outcomes for their students.

Teacher self-efficacy has been linked to student academic success (Ashton & Webb, 1986). Teachers who have low self-efficacy avoid planning learning experiences that they are not confident in teaching (Bandura, 1997). They may not support students who struggle with the topic, and they may not reteach in order for students to grasp the topic concepts (Bandura, 1997). Within the context of this theory there is a potential link between positive academic success and the degree of teachers' self-efficacy.

## Self-Efficacy

Perceived self-efficacy has an influence on motivation towards goals, effort put forth, and how one approaches adversity (Bandura, 1986). If a person believes they have low self-efficacy, they have difficulty persevering through adversity (Bandura, 2000). People with low self-efficacy are uncertain of their abilities and put forth little effort when experiencing failure. In contrast, people who have high self-efficacy believe in their abilities and put forth effort to accomplish the challenges set before them (Bandura, 2000).

### Teacher Self-Efficacy

Within the context of self-efficacy there is a direct connection between the level of an individual self-efficacy and their performance. Teachers' self-efficacy influences the academic

achievement of their students (Bandura, 1993). Teachers with high self-efficacy in their instructional practices focus more on academic learning and support students who have difficulty with academic tasks. Teachers with low self-efficacy in their instructional practices focus less on academic learning and give up on students (Bandura 1993; Gibson & Dembo, 1984).

According to Bandura (1997) and Ashton (1984), teachers' self-efficacy can have a negative or positive impact on student achievement. Teachers with high self-efficacy approach teaching quite differently from teachers with low self-efficacy. Teachers with high self-efficacy are positive about teaching and focus on meeting the academic needs of their students by guide students understanding of academic concepts being taught. Teachers with low self-efficacy view teaching in a negative manner, do not focus on the academic needs of their students, and criticize students (Bandura, 1993, 1997). Research findings denoted that teachers' self-efficacy was linked to student's academic achievement (Armor et al., 1976; Ashton & Webb, 1986; Ross, 1992, as cited in Tschannen-Moran & Woolfolk Hoy, 2001). Therefore, teacher's self-efficacy can have a negative or positive effect on student's academic attainment in mathematics.

**Teacher Self-Efficacy in Teaching Math**

Pre-service teachers and early childhood teachers in the classroom have reported low self-efficacy in teaching mathematical concepts (Bates, Latham & Kim, 2013; Chen & McCray, 2013; Haciomeroglu, 2013; Incikabi, 2013; Johnson & Vandersandt, 2011). There has been an increase in attention given to teaching mathematical concepts in early childhood education. Further, math curriculum and math standards address the mathematical concepts that should be part of the early childhood math curriculum (Tsamir & Tirosh, 2009). According to the National Council of Teachers of Mathematics (NCTM) (2006), instruction in mathematics should be

composed of problem solving, application of logical reasoning, and analysis of multiple representations. The NCTM (2015) has stated that some students are not developing the mathematical skills they need. Several studies (Bates, Latham & Kim, 2013; Chen & McCray, 2013; Haciomeroglu, 2013; Incikabi, 2013; Johnson & Vandersandt, 2011) have found that early childhood teachers are not confident in teaching math skills to young children. Studies have revealed a strong relationship between mathematics anxiety and lack of confidence in teaching practices (Boyd, Foster, Smith & Boyd, 2014; Gresham, 2009; Johnson & Vandersandt, 2011). According to Gresham (2009), teacher self-efficacy in teaching math can be the result of anxiety and found that teachers with high levels of anxiety about teaching math had low self-efficacy in teaching math.

If early childhood teachers have low self-efficacy in teaching math, have mathematics anxiety, or transfer their math anxiety to their students, then students will not develop the necessary skills needed to be successful in math (Warwick, 2008). Torre, et al. (2011) provided information about the importance of exposing young children to complex tasks, problem solving, and rigorous content. More importantly, the authors discussed how fostering these skills in early childhood are a foundation for lifelong learning. Bates, Latham, and Kim, (2013) conducted a study that focused on early childhood pre-service teachers' confidence in teaching math. Bates, Latham, and Kim (2013) stated teachers who have low self-efficacy in teaching math could negatively impact student performance. The participants reported that their fears of teaching math and engaging children in math negatively impacted their students' academic achievement.

Math is known as one of the most difficult subjects to teach to early childhood students (Pound, 2008, as cited in Incikabi, 2013). Based on the analysis of pre-service teachers both

Haciomeroglu (2013) and Incikabi (2013) found that pre-service teachers had anxiety in teaching math and the findings indicated that there was a strong relationship between teachers' mathematical beliefs and their math anxiety. Wilkins' (2008) also reported that early childhood teachers had low levels of mathematical subject knowledge and a negative approach towards mathematics.

Boyd, Foster, Smith and Boyd (2014) conducted a study that explored pre-service teachers' viewpoints on teaching math, their anxiety related to teaching math, and their understanding of where these viewpoints came from. Boyd et al. (2014) reported that pre-service teachers had high levels of anxiety in regards to their instruction in mathematics. Interesting to note is that the pre-service teachers who had low self-efficacy in teaching math reported that they would feel more confident when they take their knowledge and have the opportunity to practice this knowledge in the classroom. Studies (Chen & McCray, 2013; Iaquinta, 2014) have reported that it was not only pre-service teachers who have low self-efficacy in teaching math, but practicing teachers in the field also have low-self efficacy in teaching math.

Chen & McCray (2013) and Iaquinta (2014) conducted studies on teachers' self-efficacy beliefs. Preschool teachers' beliefs about teaching math and the teacher's confidence in teach math skills were analyzed. The results indicated that preschool teachers had low self-efficacy in teaching math and became nervous when they just heard the word math. Bates, Latham, and Kim (2013) conducted a qualitative study that focused on teaching math to young children. The participants reported that their fears of teaching math and engaging children in math would negatively impact their students' academic achievement. Bates, Latham, and Kim (2013) stated, teachers who have "low mathematics self-efficacy may lead to less confidence overall, which can

hinder actual teaching performance" (p. 2). In contrast, Seker and Alisinanoglu (2015) examined preschool teachers' beliefs and self-efficacy towards math. The authors found that preschool teachers' had high self- efficacy towards preparation of mathematics and the implementation of mathematical activities.

Iaquinta (2014) found that there are several factors that can impact teachers' self-efficacy including teacher relationships, observation of peers, and collaboration among teachers. Yesil-Dagli, Lake, and Jones (2011) conducted a qualitative study that explored pre-service teachers' beliefs about mathematics and science. Teachers beliefs related to math and science were analyzed before and after their methods course. Yesil-Dagli, Lake, and Jones (2011) found that at the beginning of the semester participants had low self-efficacy in teaching math. However, after teaching how to teach mathematical concepts throughout the semester the pre-service teachers reported an increase in their self-efficacy related to mathematical concepts. In a study conducted by Swars (2005) two teachers reported high levels of self-efficacy and two teachers reported low levels of self-efficacy. However, the teachers who reported low self-efficacy still felt they could teach mathematical concepts effectively, but they believe it would take more effort and time.

Throughout the literature review on self-efficacy, findings have ranged from teachers' high anxiety and low levels of self-efficacy in teaching math to high levels of self-efficacy in teaching math. Both qualitative and quantitative research methods have been examined to gather data on pre-service teachers and experienced teachers' self-efficacy in teaching mathematical concepts.

## Mathematics Reform

In the late 1980's stakeholders in education debated how to teach mathematical concepts. On one end of the debate were individuals who supported a concepts-first position, which focuses on abstract ideas and reasoning (Clements, Baroody & Sarama, 2013a). Supporters of concepts-first believed that young children are capable of higher order thinking that involves abstract mathematical concepts (Clements, Baroody & Sarama, 2013a). On the other end of the debate were individuals who supported a skills-first approach, which is based on simple skills such memorization through rote learning (Clements, Baroody & Sarama, 2013a). According to the National Mathematics Advisory Panel (2008), instruction in mathematics should not focus on either of these concepts separately. Mathematical concepts and mathematical skills should be taught in conjunction with each other in a manner that focuses on conceptual understanding, problem solving, and simple skills. Although, NCTM (2013) continues to support the position that young children could problem solve and reason, it has been argued that young children are not able to "understand mathematics, learn abstract mathematical concepts, or logical reasoning" (Clements, Baroody & Sarama, 2013a, p. 14). Over the past few decades, approaches to mathematical education has been debated and criticized.

Throughout the many years various strategies have been implemented without much improvement (Thames & Ball, 2013). Initiatives such as New Math, Math Wars, new curricula, high stakes assessment, and teacher incentives have had little impact (Thames & Ball, 2013). In fact, American students are further behind than most countries (Thames & Ball, 2013). The reality is that United States has not effectively prepared students in mathematics and students are not receiving the mathematical content needed to compete with other nations (Schmidt &

Burroughs, 2013). According to Program for International Student Assessment (PISA), the United States is ranked 36th in mathematics out of the 65 countries (Organisation for Economic Co-operation and Development, OECD, 2014) that participated in the triennial international survey (OECD, 2015).

## Standardized Testing

Assessments remain an integral component of the educational process and they enable stakeholders to quantify the degree of learning. Assessments are formulated in either an authentic or standardized format or a combination of both. Authentic assessments do provide evidence of learning but they are considered unreliable and do not measure up to standardized testing in relation to psychometric terms (William, 2010). Standardized testing seems to be more reliable when seeking to provide evidence of learning and improve learning outcomes (William, 2010). Standardized tests were created in an effort to determine if students met grade level criteria and to determine a student's progress, (Bhattacharyya, Junot & Clark, 2013). To ensure that students do well on the standardized tests, teachers spend a great deal of time focusing on components of the tests.

Munoz (2011) and Starr (2012) discussed the idea that focusing too much time on preparing students for ELA and Math tests decreases the time spent on other valuable subjects such as social studies, science, art, and music. Munoz (2011) stated that the results of the standardized tests enable teachers to plan better for students in the content areas being tested. This is beneficial, but by focusing on the content being tested it does not enable teachers to focus on other important subject areas. Nor does it enable teachers to develop an understanding of exactly what students are mastering. By focusing only on standardized testing, specific

competencies are not being examined (Duckworth, Quinn & Tsukayama, 2012). Further, the pressure of standardized tests has led teachers to teach lessons that teach to the test and less on teaching to students how to think (Starr, 2012; William, 2010).

Although, the criticism of standardized tests centers on the idea that it is not a true assessment of student learning outcomes or on student's skills, there are still proponents of standardized testing (Bhattacharyya, Junot & Clark, 2013). The major benefit of standardized testing is the accountability of the schools, teachers, and students (Hursch, 2011; William, 2010). Standardized testing is important in assessing students, classifying students, and identifying students' strengths and areas of opportunity (Gawthrop, 2014). Further, these tests also identify teachers' strengths and areas of opportunity (Gawthrop, 2014). Standardized testing is supported by schools, state government, and federal government because it provides quantitative data that allows policy makers to design policy and make curriculum decisions (Gawthrop, 2014). The two opposing ideological positions are pulling the debate in their respective directions. However, under the current political climate it appears that the use of standardized tests will be used for the foreseeable future.

## Common Core

Common Core State Standards were established by the National Governors Association to define a clear set of standards for English Language Arts and Math (National Governors Association, 2010). The National Governors Association (2010) stated that the standards were created through collaboration with teachers, parents, administrators and experts. Yet, Mathis (2010) stated that there was little input from educators. With only one exception, the groups that developed the standards were primarily employees of testing companies and pro-accountability

groups (Mathis, 2010). However, the Common Core was developed and adopted by the states governors and education practitioners in hopes to raise academic standards (New York State Education Department, 2010). This initiative was developed in response to low academic achievement, lack of national standards, and students not being college and career ready (New York State Education Department, 2010).

The Common Core Standards were developed with an emphasis on what students should be able to do by the end of each grade and be prepared for college or the workforce (National Governors Association, 2010). However, Mathis (2010) claimed that Common Core Standards do not reveal how well students perform nor will it improve American education. He provides recommendations for the continued use of the Common Core Standards but only as a low-stakes accountability system (Mathis, 2010). He also suggested that education stakeholders should examine comprehensive school-evaluation systems and not use high stakes tests if the assessments are insufficient (Mathis, 2010). Although there are adversaries for the Common Core Standards there are individuals that advocate for these standards.

Supporters of the Common Core Standards believe that the uniform standards establish accountability and prioritize subject matter in the areas of reading, writing and mathematics (Mclaughlin & Overturf, 2012). Within these subjects students are expected to think critically, develop problem solving skills, and high level thinking skills (Parents for Public Schools, 2015). However, many people do not see higher level thinking skills at the earlier years as a good thing. They believe that this type of academic rigor starts too early due to the Common Core Standards (Parents for Public Schools, 2015). According to Clements, Baroody, and Sarama (2013a), young children do not have the cognitive ability to learn mathematical concepts that include

abstract and logical thought. Although, the NCTM (2013) is in full support of the Common Core Standards, there are still stakeholders that retain the position these standards are too advanced for young students. These proponents base their position on the notion that young students are not intellectually ready to process critical thinking skills in mathematics.

Both sides of this debate hold the position that the educational system needs to be transformed in order to maintain an acceptable standing in relation to other higher performing nations. However, they differ on how this transformation continues to move forward. This transformation of the education system elevates our standards to a level that is comparable to standards in other countries and the raising of our current standards will improve the United States academic ranking with other countries (Parents for Public Schools, 2015). One way to transform education is to begin with a focus on the instructional practices of teachers. The standards provide a method that supports teachers by detailing a framework that guides them in their development of educational objectives (Bleiberg & West, 2014). The Common Core Standards requires educators to fortify content knowledge, adjust their teaching methods, and create aligned materials with the standards (Education First, 2014). These aspects working in consort with one another provide a solid footing in the transformation process that will allow for a higher degree of learning that takes place.

## Instruction in Mathematical Strategies in Early Childhood

Goals for early childhood mathematics should focus on conceptual understanding and mathematical inquiry (Clements, Baroody & Sarama, 2013a). More specifically, instruction in mathematics should focus on meaningful connections instead of rote learning (Clements, Baroody & Sarama, 2013a). Meaningful connections allow young children to explore

mathematical ideas and solve mathematical problems (Clements, Baroody & Sarama, 2013a). Beyond the meaningful connections, early childhood mathematical practices should foster mathematical inquiry. Mathematical inquiry includes problem solving, reasoning, and justifying solutions (Clements, Baroody & Sarama, 2013a).

According to the joint position statement of NAEYC and NCTM (2010), high quality mathematics in early childhood should focus on young children's cognitive development. This early emphasis will provide a sustained level of achievement as these children age (NAEYC and NCTM, 2010). Further, high quality mathematics curriculum should focus on children's ability to problem solve and reason (NAEYC and NCTM, 2010). Although there are misconceptions regarding the readiness of young children to learn math, Lee and Ginsburg (2009) pointed out that young children actively engage in mathematical concepts on a daily basis. Young children may naturally be inclined to participate in experiences that involve mathematical problems that are complex and sophisticated (Lee & Ginsburg, 2009). Lee and Ginsburg's (2009) inquiry into mathematics in early childhood demonstrated that young children are not only ready to learn math but they are ready to engage in math that includes critical thinking skills.

## Overview of Critical Thinking

Critical thinking encompasses problem solving, higher order thinking, language development and analytical skills. Critical thinking incorporates inferential questions, judging, and evaluation (Lai, 2011; The Partnership for the 21st Century Skills, 2014). The Critical Thinking Community (1994) defined critical thinking as "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or

communication, as a guide to belief and action." Warnick and Inch (2009) further refined the definition of critical thinking to include the concepts of problem solving and justifying the solution. Both the broader definition provided by The Critical Thinking Community (2015) and the more refined definition by Warnick and Inch (2009) have been incorporated in this study to more adequately focus on exploring solving problems and justifying the solution within the context of early childhood education.

Both NAEYC (2003) and Snyder & Snyder (2008) pragmatically stated that memorization does not support critical thinking. NAEYC (2003) emphasized the importance of engaging students in higher level thinking rather than memorizing facts. By placing importance on the support of students' development in the necessary critical thinking skills educators provide the foundation for academic growth (Lai, 2011). The Partnership for 21st Century Skills (2009) has also stated that critical thinking is a necessary component in preparing students for their future in education and the workforce (Lai, 2011). Teachers' capability to teach critical thinking skills in early childhood can have a positive impact by providing an infusion of developmental knowledge at a critical time in the brain development of young children (Epstein, 2008).

According to Salmon (2008), the introduction of routines that support the culture of thinking fostered positive attitudes toward critical thinking. Research has demonstrated that children as young as 4 years old can develop critical thinking skills (Epstein, 2008). Both Salmon (2008) and Epstein (2008) focused on the concept that critical thinking skills can be fostered in young children by creating an environment that centers on the culture of thinking and by allowing young children to express their thoughts.

Research into critical thinking supports the premise that early development of these skills, the more likely that these skills will be retained and applied (Abrami et al., 2008; Case, 2005; Halpern, 1998). The literature supports the position that unless critical thinking skills are directly taught, they most likely will not develop in young children (Lai, 2011). If children develop critical thinking skills at an early age, the more likely they will be recalled and employed (Lai, 2011). According to Schiller (2010), beginning at the age of three, brain synapses are ready to be wired. The connection of these synapses depends on social emotional and intellectual interactions (Schiller, 2010). It is these interactions throughout a young child's life that are the foundation for thinking and reasoning skills (Schiller, 2010).

## Professional Development

Early childhood educators should participate in best practices that are evidence based and foster students learning and development (Copple & Bredekamp, 2009). Some early childhood educators may not have the skills to provide best practices because they are not adequately educated in these practices (Copple & Bredekamp, 2009). Ljubetic (2012) stated that it was important for teachers to participate in training and ongoing professional development. Further, Ljubetic (2012) specified that educators should prepare students for the 21st century by focusing on teaching global awareness, while developing critical thinking and technological skills. If teachers are not being properly trained to teach 21st century students, then it may lead to poor performance on the standardized test and future academic development (Ljubetic, 2012).

Teachers need to participate in best practices that emerge from meaningful professional development. However, according to Hightower et al. (2011), the importance of professional development and student outcomes has not yet been proven. Quality professional development

did show an increase in teacher knowledge, but it did not provide evidence that this knowledge improved student academic achievement (Hightower et al., 2011). Although research has not proven a direct link between teacher preparation through professional development and student outcomes, Bouchard et al. (2010) found that teacher training was vital for student learning in the early years. Bouchard et al. (2010) discussed the importance of proper training and its linkage to pedagogical practices. This will ultimately lead to additional support for students' learning of academic concepts. According to Garet, Porter, Desimone, Birman, and Yoon (2009), professional development has the most impact on instructional practices that will support students in being academically successful.

## Review of Methodology

Lodico, Spaulding, and Voegtle (2010) defined case studies as gathering data from individuals within a group and document the experience of these individuals. Furthermore, case studies are implemented when the researcher wants to investigate, discover, and gain valuable insight into the lived experiences of the participants (Lodico, Spaulding & Voegtle, 2010). I used a qualitative case study approach to specifically examine prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions.

Qualitative case studies enable the researcher to learn more about the participants through exploration (Creswell, 2012) and enable the researcher to gather in depth understanding of the participants involved (Creswell, 2013; Merriam, 1998). According to Creswell (2013), in order to gather an in depth understanding, the researcher must collect various forms of data including interviews, observations, and documents. The aim of this study was to investigate participants'

experiences involving prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions. In order to gather a rich description of these experiences, this research incorporated the use of interviews, observations, and the analysis of mathematical lesson plans.

Considering this study was bounded both by the number of participants being interviewed and the limited amount of time for observations, this study is bounded enough to qualify as a case study (Merriam, 1998). This research focused on discovery and insight, rather than hypothesis testing. A qualitative case study was appropriate for this research in order to provide rich description of the prekindergarten and teachers' self-efficacy in teaching math that challenges students to solve problems and justify their solutions. This case study collected data through interviews, conduct observations, and analyze math lessons. The compilations of these data sets were analyzed through the case study approach.

**Interviews**

Interviews are an important method of implementation for qualitative research. Interviewing allows researchers to collect data that places the observed behavior in a broader context (Seidman, 2012). Interviews also provide the opportunity for researchers to qualitatively understand the observed action (Seidman, 2012). The purpose of interviews is to attain insightful data about participants that may not otherwise be observable (Patton, 2014). According to Merriam (1998), interviewing is the most effective technique to use when focusing on case studies of selected individuals. Interviewing enables the researcher to gather information from another person's perspective and enter their world in order to find gather their stories (Patton, 2014).

**Observations**

Interviews in conjunction with direct observation provide valuable data, which allows for a rich description of the participants lived experiences (Patton, 2014). The goal of observations is to bring the investigator into the setting of the study and allows for immersion in the environment (Patton, 2014). Observations allow the researcher to learn about behaviors in the natural environment (Maxwell, 2012). Creswell (2013) stated that observations are essential components in gathering data in a qualitative study. Observations are also considered a valuable tool when used in combination with interviews. This assists a researcher in understanding the operational context, triangulating the findings, and observing the situation firsthand (Merriam, 1998).

## Review of Different Methodologies

There are a variety of approaches when conducting research. Creswell (2013) discussed five qualitative research approaches. The two approaches that are similar to the case study approach are narrative research and phenomenological research. However, due to the differences in each of these types of research, the case study approach was the most effective approach for this study. Narrative research does collect stories and explain individual experiences, but the focus for the narrative research is to display the information in a chronological order (Creswell, 2013). Although, case study data can be organized in chronological order, the main focus is on developing themes. Phenomenological research centers on several individuals and describes their lived experiences of a particular phenomenon. More specifically, a study that focuses on phenomenological research describes what the participants have in common (Creswell, 2013). In this particular study my focus is not what participants have in common. Rather, my research

focused on teachers varied experiences and self-efficacy in teaching math that challenges students to solve problems and justify their solutions.

## Summary

This section encompassed a literature review of the conceptual framework, self-efficacy, teacher efficacy, and teachers' self-efficacy in teaching math. Topics such as mathematics reform, state standardized testing, common core, and instruction in mathematical strategies in early childhood were discussed. The review concluded with the topics of critical thinking skills, professional development, and the methodologies.

Throughout the literature review I focused my attention on providing an overview of critical thinking skills in order to establish an understanding of what is meant by critical thinking. I felt it was important to review literature that was related to all realms of self-efficacy. This literature review began with a general description of self-efficacy and then led to teacher self-efficacy and self-efficacy in teaching math. Including mathematics reform, state testing, the common core, and instruction in mathematical strategies in early childhood was important to review. It was essential to discuss how math has changed over time and how math is currently being taught. In conclusion a review on the methodologies was discussed with a focus on case studies, interviews and observations. Section 3 included the methodology with a discussion about the design, the data collection, and data analysis.

Section 3: Research Method

## Introduction

The objective of this qualitative study was to investigate prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions. The Albany school district has initiated a comprehensive plan that emphasizes the engagement of all students in high academic rigor both in math and ELA. This comprehensive plan places attention on academic rigor beginning in prekindergarten and kindergarten. Therefore, all early childhood educators need to know how to teach math with a focus on high academic rigor, which includes critical thinking. The needs assessment in Albany school district, as well as the relevant literature, supports the premise that teachers may have a low self-efficacy in teaching math and critical thinking (Bates, Latham & Kim, 2013; Chen & McCray, 2013; Haciomeroglu, 2013; Incikabi, 2013; Johnson & Vandersandt, 2011).

In conducting this qualitative case study, I developed a deep understanding of prekindergarten and kindergarten teachers' self-efficacy in teaching math that challenges students to solve problems and justify their solutions. A qualitative case study lends itself to providing a rich descriptive of the participants experiences (Merriam, 1998). A rich descriptive draws attention to the words rather than numbers to discuss the participants involved in the study, the activities that take place, and context of the study (Merriam, 1998).

This section includes pertinent information about the research design. Within the context, selection of participants and measures for ethical protection are discussed. The role of the researcher was discussed and encompasses relationships with the participants, method in

establishing a working relationship, and experiences related to the topic. Finally, as part of the design data collection methods and data analysis are discussed.

## Design

I used a qualitative case study approach to specifically examine prekindergarten and kindergarten teachers' self-efficacy in teaching instruction in mathematics that challenges students to solve problems and justify their solutions. Qualitative studies enable the researcher to learn more about the participants through exploration (Creswell, 2012) and focused on gathering a deep understanding of the topic being investigated and the participants' unique perceptions of this topic (Merriam, 1998, p. 19).

This case study was descriptive in nature and gather valuable information about early childhood educators' self-efficacy in teaching math that challenges students to solve problems and justify their solutions. According to Merriam (1998), case studies can be valuable and influential in changing policy, practice and future research. Through case study research a researcher can acquire a rich description of the topic, which can be incorporated into policy decision-making processes. The data was collected, analyzed, and compiled into stories of the participants' experiences. At the conclusion of the study researchers and practitioners will be able to better design professional development. The professional development can be provided for early childhood pre-service educators and early childhood educators in the field that challenges students to solve problems and justify their solutions.

I have considered both quantitative and mixed methods approach as alternative approaches to this study. Quantitative studies are numerically based and only convey the data statistically. The mixed method approach does provide the advantage of combining the strengths

of both qualitative and quantitative methodologies (Lodico, Spaulding & Voegtle, 2010). However, according to Lodico, Spaulding, and Voegtle (2010), a disadvantage of a mixed methods approach is it requires knowledge of both qualitative and quantitative methods, which may be challenging for a student at the beginning stages of his/her research. Another disadvantage identified by the authors was the abundance of time and resources needed to complete a mixed methods study. I have considered survey research but this approach also provides statistical data. Surveys do not allow the researcher to observe the participant or probe for further information about the experience.

This study does not lend itself to a quantitative, survey or a mixed methods approach and was most appropriately suited to be conducted qualitatively. Both quantitative approaches utilizing surveys and mixed methods approaches provide statistical data that affords a unique benefit for certain types of studies. However, the statistical data do not provide a rich description of the participants' experiences. It is these rich descriptions that remain at the center of this data collection strategy. Detailed experiences and stories will be more valuable for future professional development programs. Program developers can benefit from understanding the impact of self-efficacy on teachers' approach to mathematics instruction. The purpose of my study was to understand prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions. After giving careful consideration to each of these approaches, I have concluded that a qualitative case study with descriptive data of the participants' experiences was the most effective approach for this investigation.

## Research Questions

The research questions that guided this study were:

1. What instruction in mathematics is currently used in the Albany city school district prekindergarten and kindergarten classrooms that challenge students to solve problems and justify their solutions?
2. What is prekindergarten and kindergarten teachers' self-efficacy in their ability to challenge students to solve problems and justify their solutions?
3. What professional development workshops do prekindergarten and kindergarten teachers find most effective in supporting their self-efficacy in teaching mathematics that challenge students to solve problems and justify their solutions?

## Context

This qualitative case study took place in the Albany school district. The Albany school district is an urban school district composed of 12 elementary schools, two middle schools, one prekindergarten-grade 8th school, and one comprehensive high school. The school district services a community of 9,000 students within these schools (Albany school district, 2015). The school district is classified as a high needs urban school district with 59% of the students that receive free or reduced lunch and 50% graduation rate (NYSED, 2015).

Voluntary participants for this study were selected from the 11 elementary schools in the district instead of the 12 elementary schools due to the involvement of the researcher in one of the elementary schools. The 11 elementary schools within this school system contain five prekindergarten teachers and 33 kindergarten teachers. Within the 11 targeted elementary schools there were 38 lead teachers whom I invited to participate in the study. I invited this many

teachers with the anticipation that between six and eight participants would agree to participate in this study.

**Selection of Participants**

Purposeful sampling, typical sampling, and purposeful random sampling was used to select the prekindergarten and kindergarten teachers. Purposeful sampling enables the researcher to explore, understand and gain in-depth insight into the cases being studied (Patton, 2014). According to Creswell (2013), there are three things to consider when using purposeful sampling: participants in the sample, types of sample, and sample size. According to Creswell (2013), purposeful sampling strategy can sample from convenience, availability, political importance, marginalized individuals, or ordinary typical people. The purposeful sampling strategy used for this research incorporated typical ordinary teachers who were able to tell their stories through their lived experiences. The use of purposeful sampling allowed the researcher to select participants for this study to purposefully inform the research problem. Further, typical sampling was employed because the participants reflect the average person (Merriam, 1998). Sample size guidelines suggest collecting data from few participants (Creswell, 2013). If the sample size was larger than anticipated, purposeful random sampling was used to randomize the sample (Lodico, Spaulding & Voegtle, 2010). In a qualitative case study, more emphasis is placed on the collection of detailed and comprehensive data, rather than the size of the sample itself (Lodico, Spaulding & Voegtle, 2010). Lodico, Spaulding & Voegtle, (2010) suggest that key informants be chosen in order to provide detailed information about the topic being investigated.

**Ethical Protection**

Creswell (2013) discussed ethical issues in relation to when the ethical issues occur during the research process. These ethical issues were addressed prior to the study, at the beginning of the study, during data collection, during analysis of the data, when reporting the data, and at the publishing stage of the study. The ethical issues during each step of the study ensured that participants are protected throughout the study. Prior to the study, ethical issues were considered when seeking approval from the college, while gaining permission from the study site, and when receiving permission from the participants. I gained IRB approval from Walden University. To gain access to the Albany school district site I completed a letter of cooperation and a letter of cooperation from Research Partner. I sent the letter of cooperation and the letter of cooperation from a research partner via email to the Assistant Superintendent of the Albany school district for his approval and signature.

At the beginning of the study the following ethical issues of disclosing the purpose of the study and ensuring the participants understand that the study is voluntary in nature was addressed. To address these issues I sent an invitation letter and a consent form to the participants to inform and invited their participation in this study. These forms were emailed to the participants and sent through US postal service. The consent form was included the background of the study, the procedures, and the purpose of the study, statements about the voluntary nature of the study, risks and benefits of being the study, payment, and privacy will be included. All voluntary participants were required to sign the consent form.

During the data collection process there were ethical issues to consider that include respecting the site where the research was conducted and to make certain that the participants

were not mislead. In order to address these issues, I built trust with the participants by demonstrating respect for the field of education and answered any questions that arose. To ensure that the participants were not mislead I discussed the purpose of the study as stated in the consent form and offered participants the opportunity to seek clarification regarding the nature and intent of this study.

Throughout the analysis of the data it was important to avoid complete agreement with the participants or sharing only positive results. Respecting the privacy of the participants was vital. To address these ethical issues I discussed a variety of viewpoints and conflicting findings with the participants. Both in the analysis of data and the reporting of the data, I assigned pseudonyms for each participant for the protection and privacy of the participants.

During both the data collection process and the analysis process I kept the collected data and NVivo files in a secure password-protected file on my computer and the files were also kept in a locked filing cabinet. Throughout this investigation I upheld the highest degree of ethical standards. I did not falsify any components of the research, I did not plagiarize, and I did not discuss information that may be harmful to the participants.

In addition, I have considered ethical issues that may arise during the publishing process include duplicating other research, and sharing data with others. Addressing these issues was accomplished by providing copies of the study to the participants, and avoiding using the same material from other publications.

## Role of the Researcher

I worked as an elementary school teacher for 12 years in one of the schools targeted in this investigation. To control for possible bias due to my relationship with the local school, no

teachers were selected from that particular school. Furthermore, teachers who I have had a previous professional relationship with during my years at the elementary school were not selected as participants in the study.

**Researcher-Participant Working Relationship**

In a qualitative study it is important to ensure that the participants are welcomed and that the environment is nonthreatening (Miller, Strier & Pessach, 2009). A comfortable environment will encourage the participants to express themselves openly and honestly. Collaboration is seen as a partnership that enables both the researcher and the participants to contribute constructively to the research study (Miller, Strier & Pessach, 2009). In order to establish an effective researcher-participant working relationship, I established a collaborative and professional relationship through respect and rapport. The power of equality needs to be maintained in the researcher-participant relationship to ensure a nonhierarchical environment (Miller, Strier & Pessach, 2009).

**Researcher's Experiences**

My 12 years of teaching experience in this school district has provided me valuable insight into the practices and process involved in teaching the mathematics curriculum. I also have two years of experience administering the NYS Math standardized test. My experience within that year was proctoring the standardized test for my 3rd grade students.

## Data Collection

Data collection strategies were derived from Creswell (2013), Patton (2014), and Merriam (1998). The data collection strategies included face-to-face interviews, two observations, and an analysis of teachers' math lesson plans. Each of these data collection

strategies lent itself to a qualitative study. According to Merriam (1998), interviews and observations are primary sources of data that address the research within a qualitative study. Although documents are not a primary source of data, documents are ready-made data sources (Merriam, 1998). In addition to the use of primary data collection I also incorporated the use of secondary data extracted from lesson plans. The math lessons plans were analyzed for evidence of solving problems and justify solutions. Interviews are a valid method of data collection for qualitative research. Interviews can assist in targeting a particular topic or story and can allow the researcher to extract valuable data from this instrument can focus on a particular topic or tell a story. According to Merriam (1998), face-to-face semi structured interviews and informal conversation interviews (Patton, 2014) are effective approaches to qualitative case study research. I conducted these two types of interviews in order to understand prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics which challenges students to problem solve and justify their solutions. These two types of interview strategies were administered during the interview process. According to Patton (2014), combining a more structured interview with an informal conversation interview allows the researcher flexibility in probing questions and in deciding when to examine topics in greater depth. In a semi-structured interview the questions are a predetermined set of questions that were administered (Merriam, 1998) and in an informal conversation interview the questions are open-ended (Patton, 2014). The interview began with a semi-structured approach, and the latter part of the interview was reserved for open-ended questions.

The interview process took place within the prospective teachers' school and the interview was estimated to last approximately 60 minutes. I planned a date and time that was

convenient for the participants. The interviews were transcribed using an interview protocol guide (See Appendix A). To ensure I accurately gathered the data from the participants, the interviews were also audio-recorded. Interviewing provided an opportunity to extract valuable data related to the participants' thoughts and experiences (Seidman, 2012).

My goal was to understand individuals' stories through questioning and inquiry. Observations enable the research to observe behaviors within the natural environment. However, interviewing enables the researcher to gather information that establishes the behavior within a setting, which allows the researcher to understand the action (Seidman, 2012). Interviews and observations provided the researcher with valuable insight into prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions.

The interview protocol guide included 20 questions that addressed the research questions (See Appendix B). Patton (2014) suggested six types of interview categories that can be part of any qualitative study. Out of these six categories experience, opinions, demographic, knowledge, and feeling questions were pertinent to this study. Within each of these categories contains between three and ten questions. These questions were designed to elicit primary data pertaining to the three research questions. Probing questions were also utilized during the interview process in order to gain more details, to clarify the information being reported, and to ask for examples.

Observations were conducted to gain an understanding of prekindergarten and kindergarten teachers' self-efficacy in regards to their instruction in mathematics with a focus on critical thinking. Observations provide a direct method of viewing participants' behavior within the context (Maxwell, 2012). The observations were planned, recorded in a systematic manner,

and were used in combination with the interviews. The data collected from these areas were analyzed collectively. The observations were structured to focus attention on the participants, the activities, interactions, and conversations. Observations were recorded on an observation protocol guide developed by Creswell (2013) that included both descriptive field notes and reflective field notes.

After reviewing the literature and similarly structured qualitative research I estimated that the time to complete the data collection was six weeks. During these six weeks participants were interviewed and observed at their prospective schools. This time frame allowed for conducting interviews, conducting observations, and for member checking in order to clarify the data that was collected. Member checking was used in the triangulation process to ensure that the data are accurate and plausible (Merriam, 1998). After the interview data was coded I met with each participant privately to review the accuracy of the data.

## Data Analysis

The purpose of this study was to investigate prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions. Interviews, observations, and math lesson plans were analyzed to address the research questions. Coding began after the first data set has been collected and was continued until all interviews and observations have been completed, and math lesson plans have been collected. The data was coded using both situation and strategy codes. Situation codes are used when interview questions are focused on defining a topic and how the participants view themselves with respects to the topic (Bogdan & Biklen, 2007). I chose situation codes because my aim was to understand how the participants define their self-efficacy in teaching math that

challenges students to solve problems and justify their solutions.

Strategy codes enable the researcher to understand the methods or techniques people use to accomplish a variety of things (Bogdan & Biklen 2007). Therefore, strategy codes were used to understand the methods the participants use in their instruction in mathematics that challenges students to solve problems and justify their solutions. The data for this study was organized into both situational codes and strategy codes.

During data collection I used the NVivo 10 for Mac software package. This software was specifically designed to aid investigators engaged in qualitative inquiry (Patton, 2014; QSR International, 2015). This was done through a process of coding qualitative data such as interviews and observations and then bringing organization to this unstructured data (QSR International, 2015). Through the coding process nodes are developed which are a collection of references that assist in developing themes (QSR International, 2015). This organizational process allows the researcher to identify emergent themes from this information (QSR International, 2015). After identifying themes the researcher was better equipped to extract meaning and relevance from the data (QSR International, 2015).

The process of qualitative research requires that the investigator focus their data analysis on several key points. These include the preparation and organization of the data, the development of themes through data coding, and the visual representation of the collected data (Creswell, 2013). This investigation incorporated a case study analysis approach in the analysis of the collected data. Creswell (2013) outlined several steps in the data analysis process that incorporated into this study. The initial step involved the creation and organization of data. The second step involved the review of interview and observational data in order to develop the

initial codes. The next step required the development of a description of the case study and its placement into the broader context. Following this, I used categorical aggression as a means to determine if relevant meanings arise and patterns and themes were developed. This was followed by the interpretation of the data by developing naturalistic generalizations of what was learned from the case study. At the conclusion I visually represented the data using tables and narratives.

**Validity and Reliability**

In order to ensure that the results of this study are trustworthy, I considered issues related to validity and reliability. Both internal validity and reliability were addressed through triangulation, researcher's biases, and member checking. According to Merriam (1998), internal validity is essential because it ensures that research results align with reality. The identification of researcher's bias enables the researcher to clarify assumptions at the beginning of the study (Merriam, 1998). Reliability is difficult to address in a qualitative study due to the constant state of change in human behavior and the fact that repeating the study does not produce the same results (Merriam, 1998). However, reliability can be accomplished through detailed field notes and by using an audio recording device to capture the participants' stories (Creswell, 2013). More importantly, if the researcher presents the data in a manner that makes sense, then the results will be thought to be consistent and dependable (Guba & Lincoln, 1985 as cited in Merriam, 1998).

Triangulation was accomplished through the use of multiple resources including interviews, observations, and documents. These three modes of data collection were collectively analyzed and triangulated through the use of nodes and themes. Member checking was accomplished by ruling out misinterpretations of the participants' interviews and observations.

Member checking enables the researcher to bring the data, the analysis, and the interpretations back to the participants to evaluate the accuracy of the findings (Creswell, 2013).

This section included a thorough description of the research design. Within this chapter the selection of participants and the measures for ethical protection were discussed. Further, the role of the researcher was discussed including the relationships with the participants, the method in establishing a working relationship, and personal experiences related to the topic. At the conclusion of this chapter the topics of data collection methods and data analysis were discussed. In chapter 4 the findings of this investigation and evidence of quality was discussed.

Section 4: Results

## Introduction

For this study I focused on a local problem in the Albany school district and investigated the NYS third grade Math standardized test. Third grade students in the Albany school district have shown no improvement in the NYS Standardized Math Test over the past few years (NYS Education Department, 2014). However, third grade may be too late to develop the critical thinking skills that are required to prove proficiency (Moore & Stanley, 2010). Developing critical thinking skills during early years of schooling may be more effective than attempting to support development of these skills in the later years (Epstein, 2008; Lai, 2011; Schiller, 2010). Moreover, developing critical thinking skills in mathematics is a predictor of later school success (Clements, Baroody, & Samara, 2013b).

The purpose of this qualitative case study was to investigate prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions. Chapter 4 covers the process of generating, gathering, and recording data. The systems for keeping track of data are were described. Additionally, the findings of the study address the research questions and builds logically from the problem statement. Within the findings nonconforming data are presented in the findings section. Patterns, relationships, and themes are described. At the conclusion of this section, evidence of quality is discussed in order to demonstrate procedures that assure accuracy of the data.

## Generating, Gathering, and Recording Data

After IRB approval was received from Walden University (# 08-17-15-0434008), I began to recruit participants for my study. Recruitment for this study was conducted in 11 out of the 12

elementary schools in the Albany school district. One of these schools was removed from the sample due to extensive professional involvement by the researcher with the school, students, teachers, and administrators. The remaining 11 elementary schools within this school system employ five prekindergarten teachers and 33 kindergarten teachers. Invitations to participate in this study were distributed to all of the 38 teachers. This invitation was conducted using emails. Within the email, I provided a recruitment deadline that was set at approximately two weeks following the distribution of the email. Of the 38 teachers that were invited, seven kindergarten teachers agreed to participate in the study. None of the invited pre-kindergarten teachers responded to the invitation. The seven consenting kindergarten teachers were sent emails requesting appointments to begin the interviews and observations. The interviews and observations with all participants were conducted between October 1, 2015 and October 28, 2015.

**Interviews**

Data collected from interviews, observations, and two math lesson plans were used to address the research questions. The interview and observation data were collected congruently over a period of four weeks. All of the participants were interviewed using the interview questions (Appendix B), and they were observed at their prospective schools. The initial data collection began with interviewing the kindergarten teachers. The interview process lasted, on average, about 30 minutes. Interviews were audio recorded and transcribed in order to accurately capture the data from participants.

**Observations**

Each of the observations was conducted within the teacher's classroom during their math instruction block. Observations were recorded on an observation protocol guide (Appendix C) developed by Creswell (2013). This observation protocol guide included both descriptive field notes and reflective field notes. During the observations I transcribed the conversations that took place between the teacher and the students. In order to capture the words and actions during the observations I recorded word for word what the teacher and students said, and I also summarized the conversation.

## System for Keeping Track of the Data

After each interview and observation I stored the audio recordings and observations in Nvivo. During the data collection process and the analysis process, I kept the collected data and NVivo files in a secure password-protected file on my computer and also in a locked filing cabinet. I listened to each audio recording in its entirety and transcribed the audio recordings. According to Merriam (1998), member checking ensures that the data are plausible and enables the researcher to rule out misinterpretations of the participants' interviews and observations. Member checking was employed to ensure accuracy of the interpretations. I asked each participant if they would prefer to review the field notes from the observations and interviews by email or in person. All seven participants chose to have the field notes emailed for review. All participants stated that I captured their thoughts effectively. Member checking commenced with the first participant on October 14, 2015 and concluded on November 4, 2015.

After each participant responded, the transcribed documents and observation field notes were reviewed and coded. The coding process incorporated both situation and strategy codes.

Situation codes are used when interview questions are focused on defining a topic and strategy codes are used to understand the methods or techniques people use to accomplish a variety of things (Bogdan & Biklen 2007). Nodes were developed that identified self-efficacy related to justifying solutions and problem solving, as well as instruction in mathematics and professional development. Next, line by line coding was conducted to classify data that would align with the pre-established nodes. Based on the line by line coding, memos linked to the nodes were created in Nvivo. The memos and nodes were developed from the participants' specific responses to the interview questions and the observation data.

Qualitative research necessitates that the investigator focus the data analysis on several key points (Creswell, 2013). These key points include the preparation and organization of the data, the development of themes through data coding, and the visual representation of the collected data (Creswell, 2013). Upon completion of reviewing the nodes and memos, I began to create themes from the interview and observation data. The data from the seven participants were analyzed using the nodes and memos.

## Findings

The purpose of this qualitative case study was to investigate prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics practices that challenges students to solve problems and justify their solutions. The following research questions guided my study:

> What instruction in mathematics is currently used in the Albany city school district prekindergarten and kindergarten classrooms that challenge students to solve problems and justify their solutions?

1. What is prekindergarten and kindergarten teachers' self-efficacy in their ability to challenge students to solve problems and justify their solutions?
2. What professional development workshops do prekindergarten and kindergarten teachers find most effective in supporting their self-efficacy in teaching mathematics that challenge students to solve problems and justify their solutions?

As I analyzed the data, patterns and relationships began to emerge. Through further analysis of these patterns and relationships, six themes emerged from the data. These themes were: (a) what, how, and why questioning techniques, (b) rote instructional strategies, (c) perceptions of self-efficacy, (d) strategies: least confident and most confident, (e) types of professional development, (f) and professional development increased self-efficacy.

*Research Question 1:* What instruction in mathematics is currently used in the Albany city school district prekindergarten and kindergarten classrooms that challenge students to solve problems and justify their solutions?

**Theme 1: What, How, and Why Questioning Techniques**

The participants who challenged students to justify solutions asked how, what, and why questions. These participants also incorporated open-ended statements such as: "tell me more" and "explain your thoughts." In addition to questioning techniques that challenged students to justify solutions, several participants were able to guide students in explaining their thought process related to mathematical concepts.

**Interviews.** During the interviews I investigated the participants' instructional strategies that focused on challenging students to problem solve and justify solutions. When asked during the interview to describe a typical math lesson, participant 1 explained that she discussed math

questions and incorporated higher order thinking questions such as, “What do you see, rather than just tell them it is a square, and how are the shapes the same or different?” Participant 1 was able to explain which teaching strategies she uses to teach problem solving and justifying solutions. Participant 1 stated, “Math itself is problem solving.” She believes that problem solving strategies allow students to figure things out on their own and to justify their solutions through “what and why questions.” I asked participant 1 to provide examples of what types of questions she asked to challenge students to justify solutions. Participant 1 explained,

> I showed the kids a number on a ten frame and asked them what do you see? When students responded I see 7, I asked how do you see that? I would ask them to tell me how they see that and who sees something different? I asked, how do you see that and why do you see that?

Participant 2 defined critical thinking as “Being able to explain what you are doing.” When asked how she challenges students to think critically she responded, “Having them communicate what they are doing and communicate how to solve a math problem.” I ask them to “Describe what we are doing in math and having them be able to teach someone how to do it.”

Instructional strategies with a focus on justifying solutions employed by participant 3 included asking why and what questions. Furthermore, participant 3 has the students answer questions such as, “Why do you think this and why is that?” Finally, she believes that it is important for young children to record their thinking so she uses a math book to accomplish this task. Within her math instruction, participant 3 taught problem solving and was able to share an example of a time when she taught problem solving,

> I taught a lesson with addition sentences, problems I should say using the different kinds of math addends, addends known, addends known, sum known, and comparing. I was doing the ones with word problems they knew. They would see the problem, talk about it, turn and talk, and tell me what they know about the problem and don't know about the problem. I asked how can we think about this, what kind of problem is it? Is it a joining problem or an adding problem? We used whiteboards to record their thinking.

Participant 4 described her strategies for challenging the students to problem solve. Participant 4 specified that she would ask, "How do we figure this out and what made you decide we could use this instead?" Participant 4 also was able to define critical thinking in her own words and stated, "Having students explain how they came up with an answer not just 2 times 2 is 4 but there are 2 2's and that equals 4."

A typical math lesson for participant 5 included reading a story, a quick review of shapes and colors, number identification, and then the students participated in math centers. Through further exploration of a math and problem solving, participant 5 explained that she teaches problem solving skills all day long. She shared that problem solving focused on math is incorporated during morning meeting when discussing how many kids are in the class,

> What I do is ask how many kids are in our class and how many are absent. We do a word problem and we figure it out. Then we show the word problem in two different ways. There are 13 people here, 2 people are not here, how many would be here all together?

Participant 6 has a few teaching strategies that she used when challenging students to problem solving and justify solutions. Participant 6 asked questions such as: "How do you know," "why do you know that," and " how many altogether?" Participant 6 shared,

I do problem solving with numbers. If I have 16 pieces of candy I will put some in the bag and I will have 2 in my hand. I will ask how many are in the bag.

I asked them how can they make shapes based on other shapes. They had to pick 2 shapes that were similar-what qualities were the same. Two students picked a hexagon and a triangle. They couldn't come up with something and then one student said you can use the triangle to make the hexagon. The students made the hexagon with the triangles.

Currently, a typical math lesson in participant 6's math block included drawing shapes, building vocabulary, asking where the students see shapes in the world, and centers with pattern blocks. Participant 6 further explained a conversation about shapes that challenged students to think about what makes a shape. For example, "A triangle has 3 sides, a circle has no sides." Participant 6 then shared that a side is an abstract thought for young students, "What is a side and why doesn't a circle have sides?" In her opinion this is a good place to begin the language involved with this math concept.

A typical math lesson for participant 7 was using the math modules. Participant 7 does fluency practices, has students participate in math centers and used an exit ticket as an assessment. During math, participant 7 used mathematical teaching strategies that challenge students to problem solve and explain their thought process.

I use math talk. I have them explain their thoughts and repeat back the information back to me. I ask them to tell me more and tell me why. I ask them how they thought about that.

**Observations.** During the math partner work activity Participant 1 explained to the students that they will work with partner pairs. She explained to the students that they needed to

talk about the shapes and what they know about the shapes. Participant 1 went to the partner pairs to listen in on the conversation as well as asked what, how, and why questions to encourage students to justify their solutions. Below are excerpts from the student partner conversation and the conversation between participant one and the student partners.

Student Group One
Participant 1: "What is this?"
Student group 1: "It is a triangle."
Participant 1: "How many sides, let's count?"
Student group 1 counts
Participant 1: "Can it be a triangle?"
Student group 1: "no."
Participant 1: "What is it?"
Student group 1: "Rectangle."
Participant 1: "Why do you think it is a rectangle, what do you know about rectangles, are all the sides the same?"
Student group 1: "No, it has 4 sides."

Student Group Two
Student group 2: "How do you know it is a rectangle?"
Student group 2: "It has 4 sides?"

Student Group Three
Student group 3: "This is a hexagon."
Student group 3: "It has 6 sides?"

Student Group Four
Participant 1: "What does it most look like?"
Student group 4: "A cube."
Participant 1 "How do you know it's a cube?"
Student group 4: "It is not round."

Participant 1 also implemented a math lesson focused on sorting shapes. Participant 1 had several students go up to the board and match shapes. Then participant 1 asked one student "how did you know it was a square" and the student responded, "It had four sides." She then probed further and asked, "Why didn't you say it was a rectangle." She then asked, "What do we know

about rectangles and squares." The student responded, "They have two short sides and 2 longs sides."

Throughout the observations participant 1 asked why and how questions that encouraged the students to think deeply about the math concept being taught. When Participant 1 showed the students a triangle, one student responded that it was a square. She asked why did she think it was a square, and a conversation begun that provided evidence that this participant has the ability to challenge students to explain their thought process.

Student 1: "I see a square." (The shape was a triangle)
Participant one: "Why do you think it's a square?"
Student 1: "Because it looks like one."
Participant 1: "We are going to count the sides?"
Participant 1 asks 1 student to count the sides of the triangle
Student 1 counts the sides
Participant 1: "Do you want to change your thinking?"
Student 1: "Yes."
Participant one: "Why-how many sides does a square have?"
Student 1: "4 sides-it is not a square, it is a triangle."

I had the opportunity to observe participant 2 during one of her math lessons and her calendar lesson. During her math lesson, participant 2 taught three different math activities. The first activity she reviewed the shapes and focused on the attributes of the shapes. The second activity was a shape mystery bag and the third activity was a sorting activity. Participant 2 put a chart on the board that had a picture of the shape, the attributes and examples of the shapes. Then participant 2 brought out a cube and said, "Let's talk about our cube, what do we know?"

Student 1: "Do not roll."
Participant 2: "No curved sides?"
Student 2: "They have pointys."
Participant 2: "Corners are vertices"
Student 3: "Flat faces."
Participant 2: "How many?"
Student 4: "6."

Participant 2: “What shapes are the faces?”
Student 5: “Squares.”

During the sorting activity the students participated in sorting shapes. Participant 2 told the students that they were going to work with a partner to sort shapes by attributes and she told them, “I want to hear math conversations.” Participant 2 also explained to the students that they needed to describe to her how and why they sorted the shapes.

Student Group One
Student group 1: “The ones that do not roll have pointy sides and not pointy sides.”
Student group 1: “Let’s do rolls and not rolls.”

Student Group Two
Participant 2: “How are you sorting them?”
Student group 2: “The flat faces and pointy sides.”
Participant 2 pointed to a shape and asked does this have a flat side
Student group 2 checks the shape and puts it on the other side
Participant 2: “Why did you sort them this way?”
Student group 2: “Sphere-it doesn’t have flat face.”

Student Group Three
Participant 2: “Can you sort them another way?”
Student group 3: “Do roll and not roll.”
Participant 2: “Why do they roll?”
Student group 3: “They have stuff.”
Participant 2: “What kind of stuff?”
Students do not respond
Participant 2 went to get a cylinder to show the students
Participant 2: “Why does it roll?”
Student group 3: “Because of the face.”
Participant 2 tries to roll the cylinder on its face
Student group 3: “No.”
Student group 3: “It’s a cylinder and curvy.”
Student group 3: “It’s curvy.”
Student group 3: “It rolls.”

I observed participant 3 during two of her math lessons. During the lessons she focused on flat and 3D shapes. Participant 3 began with a discussion about shapes. She asked what are shapes and where do we see shapes. Participant 3 then guided the students in a conversation

about the sides of shapes. She held up a triangle and asked how many sides. One student answered 6 sides. Below was the conversation that took place,

Student 1: “Has 6 sides.”
Participant 3: “How many-let’s count 1, 2, 3?”
Student 1: “1, 2, 3.” (as she points to the sides)
Participant 3: “How many?”
Student 1: “3.”
Participant 3 turns the triangle and tells the students to count again
Students: “1, 2, 3.”
Participant 3: “What did you notice about the shape when we turned it?”
Students don’t answer
Participant 3: “Does it matter which way I turn it?”
Student 2: “Yes.”
Participant 3: “Why?”
Student 2: “Because you can turn it anyway you want.”
Participant 3: “Does it have 3 sides no matter how I turn it?”
Students: “Yes.”

Participant 3 also led the students in a shape sorting activity. The students had to look at a shape and decide if it was a shape or not. They also had to explain why they thought it was a shape or why they didn’t think it was a shape.

Participant 3: “Is this a triangle?” (shows a picture of a triangle)
Student 3: “Yes.”
Participant 3: “why is this a triangle?”
Student 3: “Because it has 3 sides.”
Participant 3 shows a picture that is not a triangle
Participant 3: “Is this a triangle?”
Students: “Yes.”
Participant 3: “Count the sides.”
Students: “1, 2, 3.”
Participant 3: “Count again.”
Students: “1, 2, 3, 4.”
Participant 3: Why is this not a triangle?”
Student 4: “It doesn’t have straight sides.”
Participant 3: “Is this straight?” (pointing to a line on the shape)
Student 4: “It doesn’t have the bottom.”
Student 5: “It’s open.”
Participant 3: “Are you telling me that a triangle has to be closed?”
Student 5: “Yes and it has 4 sides.”

Participant 3: “So what are you telling me?”
Student 1: “It is not a triangle.”

Participant 5 focused on encouraging students to solve a math problem during the activity with the weather graph. She prompted the students to answer how many sunny days, how many cloudy days, and how many rainy days? The students provided the correct answer to each of these questions. Participant 5 wrote the numbers on the board and said, “The numbers are 8, 6, and 1.” She asked the students which number was the greatest, which number was the lowest, and which number was in the middle. For each question the students were able to answer correctly. The final two questions she asked the students were “Is 1 less than or more than 8, and is 6 greater than or less than 1. Again the students were able to correctly answer these questions. These instructional strategies demonstrate the ability to challenge students to problem solve and explain their thinking.

Further, participant 5 takes her attendance and turns it into a math problem and she asked which students were present and absent. This was the conversation that took place during morning meeting,

Participant 5: “Who is here today?”
Participant 5 shows the pictures of the students and goes through each student’s name to see if they are here
Participant 5: “Let’s count how many friends all together.”
Students count up to 15
One student says 14
Participant 5: “What are you thinking? You said 14, why?”
Student 1: “L is not here.”
Participant 5: “Right, 14 friends are here today.”

Participant 6 was observed during her math lesson and her calendar time. During her calendar time participant 6 asked the students what comes after 29 on the calendar. The dialogue between the participant and students included the following,

Participant 6: “What comes after 29?”
Student 1: “28.”
Participant 6: “Let’s count, 27, 28, 29, 28-does that sound right.”
Several students: “No.”
Participant 6: “Let’s count from 20 to see what comes after 29.”
Students count and when they get to 29 one student says 100
Participant 6: “Does that make sense, 27, 28, 29, 100?”
Student 2: “no.”
Participant 6: “How come?”
Student 3: “It doesn’t sound right.”
Participant 6: Let’s count again.”
She counts with them and then stops at 29
Student 4 says 30
Participant 6: “Where did 30 come from?”
Student 4: “In my head.”

During part of participant 7’s math lesson the students were given white boards and asked what do you know about 0. Participant 7 had the students turn and talk about what they know about 0 and then had them show what they know on the white board. At the end participant 7 shared that one friend made a picture box with nothing in it. She asked, “Why do you think he did this?” One student responded because it is 0. Participant 7 led the students in an activity about place value. She showed them the place value chart and asked, “How many straws do we need to put in the ones pocket?” One student responded “3.” Participant 7 held up several different numbers including 6, 2, 9, and each time asked the students is this the number 3. Every time the students said no that is not the number 3. She finally showed the number 3 and the students said, “Yes it is the number 3.”

Of the seven participants in this study, two participants provided their math lesson for analysis. Math lesson plans were collected in order to explore the content of the math activities that focus on problem solving and justifying the solution. Participant 1 provided a lesson plan

based on her math studio professional development and participant 3 provided a lesson from the EngageNY math curriculum modules.

Participant 1 provided a lesson plan that she uses as part of math studio. It was vastly different from the EngageNY math module. The analysis of this lesson plan demonstrated evidence of justifying solutions through why and how questions, as well as challenging students to explain their thought process. Within this lesson, participant 1 planned the following,

> Teacher will ask questions about why shapes are important, how shapes are used or where they are seen in real life.
> When students present their shapes and their reasons for sorting them the way they did, teacher will record reasons given.
> The teacher will ask how the students sort and the reasons they give will tell the teacher whether they understand shape attributes and the names of all the 2 dimensional shapes.
> What shape is this? What do you see?
> How do you know?
> Explain your thinking.
> Do you agree/disagree? Why? How do you know?

Participant 3's lesson plan objective focused on having students explain their thought process. The lesson objective was: "explain decisions about classifications of triangles into categories using variants and non-examples." Although she provided the whole lesson from the EngageNY math curriculum module, during the observation she did not include all the activities that were part of the module lesson. The lesson component she taught focused on justifying solutions such as, "tell me about this shape," and "explain to your partner how you knew the objects you sorted were triangles."

**Theme 2: Rote Instructional Strategies**

The data collected during the interviews and observations provided evidence to support the understanding that some of the participants used instructional approaches that would be considered rote strategies. Rote strategies have been defined as memorization of facts,

definitions, and procedures (Clements, Baroody, & Samara, 2013a). Rote instructional strategies may work for some mathematical concepts. However, to ensure students develop a deep understanding, they need more than drill and skill learning strategies (Gregory & Chapman, 2013).

**Interviews.** During the interview I asked questions about a typical math lesson and teaching strategies in math. Participant 2 explained that she teaches about a 40-minute lesson, teaches a 10-minute fluency activity and some independent activities.

A typical math lesson in participant 3's classroom began with a concept related to a math standard. Participant 3 described an example of a math lesson in the following way,

> In today's lesson it was to name and identify 2D and 3D shapes. I like to try to tie everything to the standard. I like to do an activity where I am scribing with the kids or I am showing them something they are talking about it. As the year progresses they do turn and talk and work with whiteboards. I do small groups and centers. I do an exit ticket or worksheet.

During a typical math lesson, participant 4 explained that she engaged students in a mini lesson and then has them go back to their seats to work with manipulatives. She further explained that the work they are doing was connected to the mini lesson concepts. For example, she was teaching a lesson on shapes and patterns and then the students would use the manipulatives to make patterns.

**Observations.** After the review of the 3D shapes, participant 3 told the students they are going to complete a cut and paste worksheet where they had to match the flat shapes to objects that are 3D shapes. Students went back to their seats and completed the cut and paste worksheet.

Participant 3 walked around checking students' work and asked one student, "Does this look like a circle?" The student said no and participant 3 asked, "Where does it go?" During the second observation, participant 3 taught 3D shapes with the group of students. Her lesson began with an explanation of 3D shapes through examples. Participant 3 asked the students to think about a 3D movie and then explained that, "We feel like we can touch the movie." She then told the students her clock is 3D because she can reach out and touch the clock. Most of the conversation during this lesson asked the students to identify the 3D shapes.

Participant 3 shows a cube
Student 1: "Square."
Participant 3: "It does look like a square –it's not a square."
Participant 3: "Does anyone know what this is called?"
Student 2: "Box."
Student 1: "It's like a cube."
Participant 3: "You know what-it is a cube."
Participant 3: "What is something in real life that looks like a cube?"
Student 3: "Toy box."

Participant 4 taught a math lesson about flat and 3D shapes. She began with a conversation about what shapes they have been learning about. One student said they have been learning about circles. Participant 4 asked, "Is a circle flat" and the student responded, "No it is not flat." Participant 4 asked the student to look at the shape. The student looked at the shape and said, "The circle is flat." Participant 4 asked, "How many sides does the circle have" and the student said, "None." The conversation between participant 4 and her students demonstrated the difficulty in challenging students to justify the solution. This was an excerpt from her math lesson.

Participant 4: "Tell me another shape."
Student 5: "Rectangle."
Participant 4: "Flat or 3D?"
Student 5: "Not flat."

Teacher asked again if it was flat or 3D
Student 5: “Flat.”
Student 6: “Rectangle has 4 sides.”
Participant 4: “What does a rectangle have 4 of?”
Student 1: “4 triangles.”
Participant 4: “What does a triangle have?”
Student 1: “3.”
Participant 4: “3 what?”
Student 7: “3 sides.”
Participant 4: “Let’s look at the rectangle, what does rectangle guy have 4 of?”
Student 8: “4 sides and 4 vertices.”

Participant 4 guided the students through the shape lesson, however she does not have the students justify solutions or further explain their thinking. This was consistent with her response to what she believes was her least effective strategy in teaching math. Participant 4 explained that she was least confident in letting them figure out the problem on their own, which is evident throughout the observations.

I observed participant 5 during calendar time and during a math lesson. During the math lesson I observed participant 5 teaching the students colors and shapes through rote learning and repetition. The student had to identify the number that was on the card. If the student did not know the answer she asked, “What do we do when we don’t know the number?” The students responded that they needed to count the dots. After the whole group lesson she put the students into math groups and had them working on numbers 1-10 by tracing the numbers and using play dough. The play dough center was designed to encourage number identification. The students had to look at the number, identify the number and then make play dough balls to match the number. For the most part the lesson was rote learning, but there were components of the lesson that focused on problem solving skills.

The observations of participant 7 took place during calendar time and a math lesson. At calendar time participant 7 engaged students in counting, patterns, and place value. Participant 7 had students count from 1-14 to emphasize the date and she told them the date is October 14th, 2015. She then asked the students, "What is the pattern on the calendar" and "What comes next in the pattern?" The student answered, "It is pumpkin" and participant 7 responded, "Yes, it is an AB pattern." To work on counting numbers, she had the students do jumping jacks and run in place while counting.

During the math lesson participant 7 played songs about counting and had the students walk around the room counting 1-20 and then backwards 20-1. She had them come back to the rug and told the students they are going to work on something different than shapes. She brought out a white board and drew a shape on the white board. Then she showed the shape quickly and asked the students how many did they see. The student answered one when he saw the shape on the white board. She did this with the number 2 and the number 0. When the student answered 2 she asked how the student knew it was 2, but the student didn't respond. She then showed the number 4 on the white board and one student answered 3 and one student answered 4. Participant 7 said, "You think it is 4?" Another student responded with the number 5. Participant 7 said, "I hear 3, 4, and 5," and she asked the students to count. The students counted 1-4.

When she showed the number 1 the student was able to answer 1 but when she asked, "How do you know that," the student said, "Because I looked at it." After the students participated in identifying numbers on the white board she had them go back to their seats and trace the numbers 0 and 1. The conclusion of the lesson included the reading of the "I can

statements." The students echoed the teacher in saying I can identify, write and count numbers 0-10.

*Research Question 2:* What is prekindergarten and kindergarten teachers' self-efficacy in their ability to challenge students to solve problems and justify their solutions?

**Theme 3: Perceptions of Self-Efficacy**

As part of my research, I explored the participants' self-efficacy related to instruction in mathematical strategies that challenge students to problem solve and justify solutions. I found a broad range of levels of reported self-efficacy in challenging students in these mathematical strategies. The levels ranged from weak self-efficacy to high self-efficacy.

In order to ensure that each participant understood what self-efficacy was, I explained self-efficacy in the following ways: (a) self-efficacy is your belief in your ability to accomplish a task and (b) self-efficacy is related to your confidence in your ability to accomplish a task.

**Interviews.** Participant 1 revealed that her self-efficacy in teaching math with a focus on justifying solutions was low-medium.

> My self-efficacy is low medium, I was confident in teaching 2nd grade but my confidence is a little lower because I want to do those types of things, (referring to justifying solutions) but I am not there yet. I feel more confident than I did at the beginning of last year and math studio helped with that. Still just at the point where I am working at it.

Participant 2 and participant 4 reported different levels of self-efficacy. Each participant rated the reported self-efficacy on a number scale, although I did not pose a question about rating self-efficacy on a scale. Participant 2 rated herself as a 2 and participant 4 reported a medium to

high level of self-efficacy and stated, “On a scale from 1-10, I would rate myself as a 7.” Participant 2 described her self-efficacy in teaching math,

> This year I feel more confident because of the math modules. If I have a unit and look all through it and I know what the end result is I feel more confident. I feel like this year I feel more confident. I would say I am medium but I am tough on myself.

However, when asked how she would describe her self-efficacy in teaching math that focuses on justifying solutions participant 2 responded “I am weak in that, I would say a 2. I have more confidence in teaching English Language Arts.” Participant 2 described her feelings about teaching math that challenges students to problem solve and justify solutions and simply responded, “I think I need to work on it.” Participant 4 explained that she feels confident in kindergarten and stated, “I feel pretty confident.”

Participant 3 described a time when she was teaching problem solving and how difficult it was for her to teach problem solving to kindergarten students. Participant 3 said she asked the math coach to observe and provide feedback in order to increase her ability to teach problem solving. Participant 3 described her self-efficacy in math as an advanced beginner. She related her self-efficacy in teaching math to “Skiing the green slopes.” She explained that last year she was a beginner but now she views herself as an advanced beginner because she is willing to try more related to math. Participant 3 shared that in the past, teaching math scared her but she is not afraid of math anymore. She used to rely on worksheets and she knew that was not beneficial to the students.

Participant 5 said her self-efficacy was moderate but further explained why she described her self-efficacy as moderate,

> I am moderately self-confident for two reasons. I was never good in math and I am mostly moderate because of the frustration of the language barrier between myself and my students. I feel frustrated that there is never a true understanding of their mastery. My confidence comes down to this.

Participant 6 reported her self-efficacy in teaching math that focuses on justifying solutions as moderate and she stated, "I am getting there." Participant 6 described her self-efficacy as moderate but stated, "I am getting there but I feel more confident in teaching English Language Arts than Math." In regards to her self-efficacy in teaching math with a focus on justifying solutions participant 6 shared,

> It is hard to go from being direct. This is why we do this and there is one way to do it. I wasn't as open for them to make mistakes and learn for themselves. I felt they needed to know it and give math fact sheets, now there is more of an emphasis on critical thinking and open ended thought process. Working through a solution asking how you know it. Sometimes I feel I am not as strong because I am still learning, learning how to let go of control and not tell them things and let them figure out for themselves, I have a long way to go. I'm getting better at it, I feel I am getting better of having them explain their answer to me, being able to justify the answer was never there when I started 10 years ago. It is new for me to think about this. I am getting there.

**Theme 4: Strategies: Least Confident and Most Confident**

During the interviews conducted during this study, I presented questions such as: "what instruction in mathematical strategies are you most confident in and least confident in to challenge students to problem solve and justify solutions?" All the participants were able to

identify at least one strategy they felt confident about and one strategy they that did not feel confident about related to justifying solutions.

**Interviews**. When I asked participant 1 how she felt about teaching math and challenging students to justify solutions she responded that she is "Waiting to feel as comfortable as she did in 2nd grade." She discussed the degree of comfort in teaching 2nd grade and she explained that she is trying to remember to ask those higher-level questions throughout her lessons. Participant 1 explained that she felt most confident in modeling for students on how to represent a problem and teaching them how to make their thinking visible. However, she also explained that the math strategy she feels least confident in is questioning but she said, "I am getting better at questioning." She further explained that participating in math studio helped her ask these types of questions and it helped get kids ready to explore and solve problems on their own.

Participant 2 explained that she felt most confident in mathematical questioning techniques but least confident in "Getting them to think beyond the question and explain their reasoning." Participant 2 further explained that, "The thing about kindergarten, it is introductory. I have a hard time bringing it to the next level." Her moderate self-confidence in questioning techniques is evident as she answered the question about her teaching strategies that challenge students to justify solutions.

> The main thing I have been trying to do is a whole debriefing section at the end of the lesson. Having key questions to ask. The debrief is where I am realizing what they are struggling with and what they understand. The debrief part of it I have key questions and I take the questions from the modules.

Participant 3 has more confidence in teaching math this year compared to previous years and explained that she has a more critical eye when deciding how to teach math in kindergarten. When asked to describe her confidence in teaching math that is focused on justifying solutions participant 3 responded,

> I think what I need to do is go back and think-what I was doing in 2nd grade. I was using justifying and how can I bring it down to kindergarten. I know what I should be doing and I plan on getting the math coach to help me and model the math lessons. Sometimes, I still feel like a beginner in kindergarten.

Participant 3 stated that she feels that the math strategy she was most confident in having students record their thoughts in their notebooks. When asked about the strategy she is least confident in she was unable to identify a particular strategy but explained that she needs to know more strategies and she needs to become more knowledgeable about these strategies. When asked about how she feels about teaching math that challenges students to problem solve and justify solutions, participant 3 explained, "I am getting better at it and enjoying it more." She also discussed how math used to be taught as recall but now they need to understand why two plus one equals three.

When asked how participant 4 feels about teaching math with a focus on justifying solutions she shared that she was "Excited but nervous. Excited because when the light bulb goes off but nervous they won't get everything they need for math. I feel more confident in teaching English Language Arts." When asked about which mathematical teaching strategies she felt most confident in and least confident in participant 4 shared, "I feel confident in conducting mini lessons and least confident in letting them figure out the problem on their own."

Participant 5 also shared her thoughts on her confidence in teaching math with a focus on justifying solutions. She explained that she has to work on the basic math concepts and for her students it is mostly repetition. However, she described what she does in math to support students in developing critical thinking skills.

> I use the English Language Arts techniques when teaching math. What helps in math is giving them visuals and prompt cards. I give picture cues and prompt them by saying I used…and they need to figure it out. Once we have learned a routine I can help students expand on the math concepts.

When asked what mathematical strategies she felt most confident in and which strategies she felt least confident in, participant 5 responded that she feels confident in differentiating instruction and providing prompts. Participant 5 revealed that the strategies she feels least confident in is all of them, because she feels she needs to keep up with other kindergarten teachers.

Participant 6 explained that even though she is feeling more confident in having the students explain their answer, she still needs more strategies on how to do this more effectively. I asked participant 6 how she felt about teaching math and she said, “I don’t know and I used to like math.” Participant 6 further explained,

> I get uneasy about it. It’s a little daunting. How am I going to get them there? I look at the test they are going to need to pass and I don’t have enough time to get them where they need to be. It seems a lot and pretty intense. I look at the math shape test and I thought I was doing a good job but I don’t think they can pass, I am little nervous. I feel it is not a clear cut.

Participant 7 responded that her confidence is high because she knows where the students are in math. Participant 7 explained that the mathematical strategies that she feels most confident in teaching is engaging students in kinesthetic learning. She also feels she is confident in teaching them problem solving skills. She shared this example, "I tell them a number they have to get to, so for example 9 is the number they have to get to but they can't start at 1 they have to start at 3 and count up to 9." Participant 7 shared that her least confident strategy within her instructional practice was the "questioning technique, especially when the students answer it wrong."

*Research Question 3:* What professional development workshops do prekindergarten and kindergarten teachers find most effective in supporting their self-efficacy in teaching mathematics that challenge students to solve problems and justify their solutions?

**Theme 5: Types of Professional Development Provided or Attended**

According to the participants in this study, there were two components of the district professional development focused on problem solving and justifying solutions. The first component is math studio, which is offered 10 times throughout the year. Math studio is focused on pedagogy and math content. The second component of math studio is inviting the math coach into the classroom to model math lessons and the coach observes the teacher's math lessons in order to provide feedback. During the interview, participants not only described what professional development is provided that supports their self-efficacy in challenging students to solve problems and justify their solutions, but they also described which professional development they attended.

**Interviews.** Participant 1explained that math studio supported teaching practices that challenged students to justifying solutions. The main focus of the workshops was math talk, which is a questioning technique to support critical thinking. Participant 1 took advantage of professional development that focused on math and worked with a math coach. During the interview, participant 1 indicated that she attended the district professional development, invited the math coach in to model mathematical strategies, and had the math coach observe her math lessons in order to receive feedback. Participant 1 specifically attended professional development that supports teachers in challenging students to justify solutions.

When asked about professional development experience related to math, participant 2 shared that she doesn't attend professional development on a regular basis. She meets with the math coach once in a while and talked about the math units. At one point she attended a 4-day STEM training that focused on problem solving.

Participant 3 visited a local school and observed a teacher during her instruction in mathematics. She also follows teacher blogs and math focused webinars. When asked if she has attended professional development focused on challenging students to justify their solutions participant 3 shared,

> Not really, during one workshop last year the math coaches tried to do it on higher order thinking and deep depth of knowledge questions. It was done for a staff meeting for an hour after school. You need a series, an hour over four weeks, and maybe two all day sessions. The district doesn't offer the appropriate level. They give us the icing and we need to do is dig down into the cake.

Participant 4 reported that she has not attended math studio and on occasion she invites the math coach in her classroom to model lessons. She also observed a teacher who participated in math studio. Participant 6 shared that she rarely goes to district professional development and she does not attend math studio. Further, she has not invited the math coach into her room to model lessons or receive feedback. However, she did observe a teacher who attended math studio.

Participant 5 and participant 7 have not attended district professional development focused on math, but they do invite the math coach in their classroom to demonstrate mathematical strategies. During the interview, participant 5 explained that she does not regularly attend professional development workshops because most are not designed for her class. She teaches in a self-contained classroom with students who are on the autism spectrum. However, participant 5 stated, "It is more appropriate to meet with the math coach to learn about mathematical strategies." She also invites the math coach in to her class to demonstrate effective strategies in specifically supporting her students in problem solving skills related to math.

Participant 7 makes a concerted effort at developing her teaching effectiveness by attending STEM (Science, Technology, Engineering and Math) workshops. Participant 7 has participated in STEM professional development and she works with the math coach on instruction in mathematical strategies. She has identified STEM and working with the math coach as professional development that has provided effective strategies in challenging students to solve problem and justify solutions.

**Theme 6: Professional Development Increased Self-Efficacy**

While addressing my third research question I engaged participants in a conversation on professional development training and how these trainings support their self-efficacy. Two of the participants were able to describe their experiences as having a connection between their participation in professional development training and elevations in their self-efficacy in teaching mathematics.

**Interviews.** Although participant 1 reported that her self-efficacy was low-medium, she did state that the math studio and working with the math coach has increased her self-efficacy. Participant 1 further explained that her increased self-efficacy enables her to teach mathematical strategies that focus on justifying solutions. Participant 5 stated, "
Working with the math coach has slightly increased my self-efficacy because the math coach provided realistic strategies to work with my students." She also mentioned that the strategies the math coach provided for her has given her the ability to challenge students to use problem-solving skills.

## Summary

The purpose of this qualitative case study was to investigate the participants' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions The data sources included in this chapter were collected and analyzed in order to address the three stated research questions. I collected data from interviews, observations, and math lesson plans. The data was organized under six themes.

## Evidence of Quality

When constructing this research, the issues of validity and reliability were addressed in order to strengthen the trustworthiness of the study. Trustworthiness was established through a positive and respectful working relationship that enabled the participants to voice their responses openly and honestly. According to Miller, Strier, and Pessach (2009), a professional collaborative environment is an essential component in research design to build the trustworthiness between researcher and participant.

Reliability in a qualitative study can be achieved by incorporating a multi-step approach to data collection that includes both detailed field notes and audio recording of the interviews (Creswell, 2013). To achieve reliability in this study both of these forms of data collection were incorporated. Reliability demands that the results are the same if the study is replicated. Dependability enables the researcher to make sense of the data (Merriam, 1998) and it is recommended that qualitative researchers employ dependability in their research design (Lincoln & Cuba, 1985, as cited in Merriam, 1998). The results of this research are dependable due to the alignment and consistency with the research literature. To enrich internal validity there are six strategies that have been highlighted in the literature and experiences of seasoned researchers (Merriam, 1998). Four of these strategies were employed in this study. Evidence of quality was accomplished through the identification of the researchers' biases, data triangulation, long-term observation, and member checking.

According to Merriam (1998), the acknowledgment of researcher's bias allows the researcher to clarify the researchers' assumptions at the beginning of the study. The biases that were identified included the work of the researcher within the school district as well as the

researchers' assumptions as part of the study. To control for possible bias due to my relationship with the local schools, no participants were selected from the school where I was previously employed nor participants who I had a previous professional relationship with in the school district. The assumptions that were made included the following:

1. The teachers who participated in the study answered interview questions to the best of their knowledge by answering honestly and accurately.
2. The teachers who participated in the study were representative of the school district.
3. The documents provided by the teachers were an accurate description of their lessons.
4. Teachers did not base their answers on a perceived level of self-efficacy.
5. The math lesson observations were reflective of daily practices.

Triangulation was accomplished through the use of multiple data collection resources including interviews, observations, and lesson plans. One interview and two observations were conducted with each participant. During the interview the participants' responses were scribed and audio recorded to enhance internal validity. During the observations I gathered detailed notes using the observation protocol (Appendix C). The initial research design was constructed with the anticipation that participants would be willing to share the mathematics lesson plans. However, only two participants were willing to provide a lesson plan. I was able to extract valuable data from these two lesson plans that focused on challenging students to justify their solutions. The three types of data collection was collectively analyzed and triangulated through the use of nodes, pattern, relationships, and themes. This was done through a process of coding qualitative data such as interviews and observations and then bringing organization to this unstructured data (QSR International, 2015). Through the coding process nodes were developed,

which are a collection of references that assist in developing themes (QSR International, 2015). This organizational process allowed the researcher to identify emergent themes from this information (QSR International, 2015).

Merriam (1998) suggests that either long-term observations or repeated observations be conducted to enhance internal validity. Therefore, repeated observations were conducted within the classroom. Two observations of the each participant were completed. The participant decided which day and time the observations would be conducted. Six of the seven participants chose their math block and their calendar time due to the math concepts that they cover within calendar time. One participant chose her math block for both observations. In doing this, data was gathered over a brief period of time and increased the validity of the results.

Member checking was employed to ensure accuracy of the interpretations. I asked each participant if they would prefer to review the field notes from the observations and interviews by email or in person. All seven participants chose to have the field notes emailed for review. All participants stated that I captured their thoughts effectively. Member checking commenced with the first participant on October 14, 2015 and concluded with the last participant on November 5, 2015.

Section 5: Discussion, Conclusions, and Recommendations

## Introduction

The goal of this qualitative study was to investigate prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions. The Albany school district's comprehensive plan (2014) is focused on academic rigor beginning in prekindergarten and kindergarten. All early childhood educators need to know how to teach math with a focus on high academic rigor. The Albany school district (2014) has clearly defined high academic rigor as having elevated levels of academic engagement. For example, students who have the ability to explain numerical problems demonstrate a higher cognitive ability than students who can simply memorize numerical problems (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010).

Teaching mathematical inquiry in early childhood education has increased over the past decade (Tsamir & Tirosh, 2009) and the goals for mathematics in early childhood are now focused on conceptual understanding and mathematical inquiry rather than rote learning (Clements, Baroody & Sarama, 2013a). Mathematical inquiry includes problem solving, reasoning, and justifying solutions (Clements, Baroody & Sarama, 2013a). With this focus on mathematical inquiry in the early years it necessitates the need for early childhood teachers to be prepared to teach mathematical concepts through inquiry based learning. However, research has shown that pre-service teachers and early childhood teachers in the classroom have reported low self-efficacy in teaching mathematical concepts (Bates, Latham & Kim, 2013; Chen & McCray, 2013; Haciomeroglu, 2013; Incikabi, 2013; Johnson & Vandersandt, 2011). According to

Warwick (2008), students will not develop the necessary math skills needed to be successful in math if early childhood teachers have low self-efficacy in teaching math.

In order for teachers to increase their self-efficacy in teaching mathematical concepts with a focus on inquiry, teachers need to participate in best practices that emerge from meaningful professional development. Attending or participating in quality professional development does show an increase in teacher knowledge (Hightower et al., 2011). Teacher knowledge of mathematical concepts that focus on inquiry will lead to an increase in self-efficacy related to teaching mathematical concepts. Yesil-Dagli, Lake, and Jones (2011) conducted a study on pre-service teachers' self-efficacy with a focus on concepts of mathematics. The authors found that at the beginning of the semester participants had low self-efficacy in teaching math. However, after being exposed to teaching mathematical concepts throughout the semester, the pre-service teachers reported an increase in their self-efficacy related to mathematical concepts.

The purpose of this study was to investigate prekindergarten and kindergarten teachers' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions. In order to explore this concept, I designed three research questions. The first question asked the participants to describe the instruction in mathematics used to challenge students to problem solve and justify solutions. The purpose of the second question was to develop an understanding of the participants' self-efficacy in challenging students to problem solve and justify their solutions. The final question asked the participants to describe professional development that focuses on instruction in mathematics that challenges students to solve problems and justify their solutions.

The research questions that guided this study were:

1. What instruction in mathematics is currently used in the Albany city school district prekindergarten and kindergarten classrooms that challenge students to solve problems and justify their solutions?
2. What is prekindergarten and kindergarten teachers' self-efficacy in their ability to challenge students to solve problems and justify their solutions?
3. What professional development workshops do prekindergarten and kindergarten teachers find most effective in supporting their self-efficacy in teaching mathematics that challenge students to solve problems and justify their solutions?

A qualitative case study was incorporated to address the three research questions. The qualitative case study design allowed the development of a rich description and an in-depth understanding of kindergarten teachers' self-efficacy in teaching math that challenges students to solve problems and justify their solutions.

Data for this qualitative case study were collected through interviews, observations, and two lesson plans. Two observations were conducted for each participant in the study. Data collected from these observations focused attention on the participants' instruction in mathematical strategies. Participant 1 and participant 3 provided their math lessons for the observations that were conducted during their math block. When the math lessons were analyzed, the focus of the analysis was math activities that included problem solving and justifying solutions.

The interview questions (Appendix B) gathered primary data pertaining to the three research questions. Patton (2014) suggests six types of interview categories that can be part of

any qualitative study. Out of these six categories I used background, experience and behavior, opinions and value, knowledge, and feeling questions. The background questions were designed to gather basic information about the participants teaching careers including teaching experience and number of years teaching in kindergarten. The experience and behavior questions focused on the participants' instruction in mathematics. These questions allowed for data to be collected that would assist in addressing the first research question. The opinion and value questions were designed to elicit data about four specific concepts. These four concepts were: critical thinking, self-efficacy in teaching math, instructional strategies, and professional development related to mathematics. The opinion and value questions were designed to address the second and third research questions. The feeling questions were developed to address the second research question and focused on how the participants felt about teaching kindergarten, teaching math, and teaching critical thinking. Finally, the knowledge questions were designed to explore the participants' description of professional development, math curriculum, training in critical thinking, and training in the Math Common Core standards. The knowledge questions were created to address the third research question.

This research incorporated a case study analysis approach. The analysis approach included organization of the data, the development of the initial codes, the development of patterns and relationships, and the development of themes. Through the analysis of the data six themes emerged. These themes were: (a) what, how, and why questioning techniques, (b) rote instructional strategies, (c) perceptions of self-efficacy, (d) strategies: least confident and most confident, (e) types of professional development, (f) and professional development increased self-efficacy.

The analysis of the data revealed a connection between professional development, self-efficacy, and instructional strategies. More specifically, participants who attended district professional development programs demonstrated the ability to challenge students to problem solve and justify solutions. Even though these participants attended professional development programs, the level of ability to challenge students to problem solve and justify solutions varied by participants. With respects to self-efficacy, the data revealed that the participants who reported high self-efficacy lacked the skills to challenge students to justify solutions, but these participants were able to challenge students to perform basic problem solving strategies. The participants who reported low to moderate self-efficacy had the ability to demonstrate strategies to challenge students to problem solve, to make students justify solutions, and to have students explain their thought process. These findings are in contrast with Bandura's (1997) conclusions about self-efficacy. Bandura believed that teachers with high self-efficacy approach teaching in an optimistic manner, provide opportunities of in-depth learning, and focus on the academic needs of the students (Bandura, 1997). The participants who reported low to moderate self-efficacy were able to provide opportunities for in depth learning for students.

## Interpretation of Findings

The purpose of this study was to investigate the participants' self-efficacy in their instruction in mathematics that challenges students to solve problems and justify their solutions. Additionally, participants' instruction in mathematics used to challenge students to problem solve and justify solutions was explored. I gained knowledge on which professional development programs were effective in supporting the participants' self-efficacy, as well as professional

development programs that focused on how to challenge students to solve problems and justify solutions.

**Research Questions**

*Research Question 1:* What instruction in mathematics is currently used in the Albany city school district prekindergarten and kindergarten classrooms that challenge students to solve problems and justify their solutions?

Through the analysis of the data I have concluded that the instruction in mathematics that focused on problem solving and justifying solutions included having students explain their thought process and asking why, how, and what questions. All the participants used why, how, and what questions but the frequency and level varied by participants.

During the observations, participant 1 showed an in depth understanding of how to challenge students to problem solve and justify solutions by asking why and how questions. More importantly, participant 1 had students explain their thought process several times throughout the lesson. For example, participant 1 asked questions such as: “How did he know it was a square” and “Why didn’t you say it was a rectangle?”

Participant 2 demonstrated through the interviews and observations that she has the ability to challenge students to problem solve, justify solutions, and explain their thought process related to mathematical concepts. Although participant 2 stated that her self-efficacy is low, she had a good grasp on challenging students to problem solve, justifying solutions and having students explain their thought process. However, participant 2 has stated that she has difficulty having students explain on a deeper level why their solution makes sense. This was consistent with the data from the observations. Participant 2 does ask why questions, but she is unable to

support the students' development of in depth thought processes. For example, in her math lesson on sorting shapes she asked the students why particular shapes roll. The students' first answer was "Because it has stuff." Throughout the conversation participant 2 attempted to have the students focus on why the shapes roll. The students finally answered, "It is curvy," but they could not specifically state why curvy shapes roll. Potentially, participation in math studio could increase her self-efficacy and enable her to teach the students to grasp mathematical concepts on a deeper level.

Participant 3's interviews and observational data aligned with respects to her focus on both rote learning and justifying solutions. During the interview participant 3 discussed one of her typical mathematical lesson plans in a way that incorporated rote learning. However, when asked to describe a time when she taught problem solving, she was able to explain how she challenges students to explain their thinking. The observations revealed instructional strategies that focus both on rote learning and justifying solutions. Throughout the observations participant 3 did ask why, how and what questions. Yet, some of the instructional strategies were focused on rote learning. For example, during the sorting activity participant 3 had student's explain why they thought pictures of a triangle and non-triangle were shapes or not shapes. Then during the lesson on 3D shapes, participant 3 just had the students name the 3D shapes and had the students complete a worksheet. Participant 3 had several opportunities during the 3D shape lesson to ask why and how questions.

Of the participants who had limited exposure to professional development, participant 4 focused more on rote learning, but did have some ability in challenging students to problem solve. A possible reason participant 4's instruction in mathematics focused on rote learning was

because of her limited time spent in professional development workshops. Participant 4 did not attend district wide professional development. However, she has observed another teacher who attended math studio. During part of her math lesson she was able to challenge students to problem solve, which could be due to her observation of the teacher who attended professional development. I can conclude that her limited exposure to professional development has had an impact on her ability to challenge students to justify their solutions

Participant 5 had a thorough understanding of mathematical strategies that supported her students in developing problem solving skills. This was evident in her conversation with the students about how to solve math problems, social problems, and non-verbal expression of their thought processes. Although participant 5 reported her self-efficacy as moderate, she was able to explain how to challenge students to justify solutions and they demonstrated this ability during math lessons.

Though participant 6 has not attended math studio or invited the coach into her classroom, she has the ability to challenge students to problem solve and justify solutions. During the math component in her calendar lesson she had students figuring out the solution to her question and has the students explain their thoughts on which number came next on the calendar. Her ability to support students in figuring out answers on their own can be attributed to observing the other teacher. Potentially, the observation of the teacher has enabled her to challenge students to problem solve, justify solutions, and have students explain their thought process.

Participant 7 explained that in order to challenge students to justify solutions she incorporated skills such as: “Math talk, explain, repeat back, tell me more and tell me why, and

how did you think about that?" However, when asked about which strategy she was least confident in, participant 7 explained that she was least confident in the questioning techniques. Even though participant 7 was least confident in using questioning techniques, she was able to explain mathematical strategies that would be incorporated in the questioning techniques when asking students to justify solutions. Therefore, these two ideas are in conflict with each other.

*Research Question 2:* What is prekindergarten and kindergarten teachers' self-efficacy in their ability to challenge students to solve problems and justify their solutions?

As previously explained, the participants who reported low or moderate self-efficacy had the ability to focus on both problem solving and justifying solutions. The participants who reported high self-efficacy had the ability to engage students in problem solve strategies, but not to challenge them to justify solutions.

Participants 1, 5, and 6 all reported that their self-efficacy in problem solving and justifying solutions was moderate. Although participant 1 claimed that her self-efficacy was "Low-medium" her teaching strategies suggest that she has a good understanding on how to challenge students to problem solve, justify solutions and have students explain their thought process. During her math lesson, participant 1 used questioning techniques that challenge students to demonstrate their thinking as they explained how they figured out a problem and why they thought the solution to the problem was accurate.

Participant 5 said her self-efficacy was "Moderate" and yet she has the ability to support students in problem solving. For example, every morning she has the students use their problem solving skills to solve mathematical word problems. Participant 5 has a class composed of students with moderate to severe disabilities. Her students are unable to express their thoughts

through words but she has them express their thoughts through other avenues such as musical expression. She also allowed them to demonstrate their thoughts to a math question by pointing and using visuals to show their thinking.

Participant 6 reported her self-efficacy as moderate because in her opinion she has a "Difficult time letting go of control and letting them figure out the solutions on their own." Even though she reported this in her interview, during the observations she had no difficulty challenging students to justify solutions. During her calendar lesson when students kept incorrectly answering the question about what number comes next, participant 6 probed further for students to explain their thinking. She asked questions such as: "Does that sound right," "let's count again," "does that make sense," and "how come?" By doing this, participant 6 engaged the students in problem solving and justifying their solutions. According to Ashton (1984), teachers' knowledge and instructional approaches have the greatest impact on student performance. Findings in this study are consistent with this concept due to the ability of these participants to engage students in conversations that focused on problem solving and justifying solutions.

Participant 2 reported her self-efficacy as weak and participant 3's reported self-efficacy in challenging students to justify solutions is advanced beginner. Participant 2 said she would consider herself a 2 on a scale from 1 to10. Inferential analysis suggests that if participant 2 attended math studio her self-efficacy may be increased and she may have the ability to bring students to a deeper level of understanding. Participant 3's reported self-efficacy as advanced beginner could be due to her participation in webinars, blogs and observing other teachers teaching math with a focus on justifying solutions. However, it can also be implied that if she did attend district wide professional development her self-efficacy would increase.

Participants 4 and 7 reported their self-efficacy as high and participant 4 specifically said she would give herself a 7 on a scale from 1 to10. Although participant 4 does not regularly attend district professional development, she has reported her self-efficacy in challenging students to justify their solutions as 7 out of 10 on a scale from 1-10. For participant 4 I concluded that professional development does not have an impact on her reported self-efficacy. Participant 7 stated that her confidence was "High" in justifying solutions but reported that she doesn't feel confident in questioning techniques that support the justifying solution concept. This was consistent with Bandura's (1997) belief about perceived self-efficacy. Perceived self-efficacy relates to what one believes they can accomplish and the number of skills they have attained (Bandura, 1997).

According to Bandura (1997), self-confidence has a close association with self-efficacy. Both of these concepts are one's beliefs in his or her abilities. This association is evident in five out of the seven participants within this study. The participants who reported moderate self-efficacy also reported confidence in teaching math as low to moderate. The interview with participant 1 provided evidence of this association. During this interview participant 1 stated that she was "Waiting to feel as comfortable as she did in 2$^{nd}$ grade." While interviewing participant 5 she stated that she felt least confident "In all of the mathematical instructional strategies because she feels a need to keep up with the other kindergarten teachers." Participant 6 explained that she becomes nervous when she reflects on the intended outcomes of the mathematical concepts that are incorporated into the unit assessment. She explained that she feels confident in her abilities in teaching mathematical concepts. In retrospect she makes a comparison between

her intended outcomes and the targeted expectation defined at the conclusion of the unit and this comparison deflates her self-confidence in meeting the intended objectives.

In contrast to Bandura's (1997) explanation that self-confidence is closely associated with self-efficacy, interviews of two participants in this study revealed their self-efficacy was in opposition to their self-confidence in teaching math. While interviewing participant 4 she stated that her self-efficacy was a "7 out of a 10" on a 1-10 scale. Yet, Participant 4 directly stated that she felt more confident in teaching English Language Arts than she does in teaching math. Participant 7 reported her overall self-efficacy in teaching math was high. Yet, her confidence in mathematical questioning techniques to challenge students to justify solutions was low.

*Research Question 3:* What professional development workshops do prekindergarten and kindergarten teachers find most effective in supporting their self-efficacy in teaching mathematics that challenge students to solve problems and justify their solutions?

Participant 1 and participant 5 have acknowledged that due to the participation in district wide professional development their self-efficacy in challenging students to problem solve and justify solutions has increased. Participant 1 and 5 admitted that participating in the professional development has strengthened their instructional practices that focus on problem solving and justifying solutions. The analysis of the data supported the position that professional development has an impact on kindergarten teachers' self-efficacy and instruction in mathematics. They did not discuss whether math studio or the math coach had the greater effect on their increased self-efficacy and instruction in mathematics.

Participants 1, 5 and 7, stated that professional development that focused on problem solving and justifying solutions was math studio and working with a math coach. Participant 1,

5, and 7 explained that they attended professional development that focused on teaching them how to include problem solving and justifying solutions in their instructional strategies. Participants 2, 3, 4, and 6 did state that observing teachers who attended math studio helped them in understanding how to challenge students to problem solve and justify solutions.

**Review of the Literature**

A review of the literature supports the idea that early childhood teachers have low self-efficacy in teaching math (Bates, Latham & Kim, 2013; Chen & McCray, 2013; Haciomeroglu, 2013; Incikabi, 2013; Johnson & Vandersandt, 2011). The results of these studies support the concept that early childhood teachers have low-self efficacy. Five of the seven teachers interviewed reported low self-efficacy in teaching math that challenges students to justify their solutions.

Research supports the premise that some early childhood educators may not have the necessary skills in teaching math because they are not adequately trained. If teachers are not being properly trained then students may perform poorly on standardized tests and their future academic development may be jeopardized (Ljubetic, 2012). It is vital for early childhood teachers to participate in ongoing professional development (Ljubetic, 2012). Bouchard et al. (2010) has not been able to prove a direct link between teacher training and student outcomes. However, within their research they discussed the benefits of professional development as a linkage to pedagogical practices. The data I collected was consistent with Bouchard's et al. (2010), ideologies. Four out of the seven participants in this study did not consistently attend the district wide math professional development, and yet they were able on some level to challenge students to problem solve and justify solutions.

Garet, Porter, Desimone, Birman, and Yoon (2009) concur with Bouchard et al. (2010), as the authors found that professional development has a direct impact on instructional strategies that support students in being educationally successful. The data I collected was also consistent with Garet, Porter, Desimone, Birman, and Yoon's (2009) ideologies. Three out of the seven participants did attend professional development and demonstrated the ability to challenge students to justify solutions.

As Bouchard et al. (2010) stated, there may not be a direct link between professional development, instructional practices, and student outcomes. The findings of Bouchard et al. (2010) resonated within this study. Participants 3 and 6 have observed other teachers within their building who have attended the professional development. Participant 2 sporadically attended general math professional development. Participant 5 invited the math coach in her classroom to model math instruction that centered on justifying solutions. Although these four participants do not participate in continuous professional development, they are still able to demonstrate skills that focus on supporting students in justifying the solutions.

Participant 1, 2 and 6 in this study have demonstrated the most effective strategies to not only challenge students to justify solutions but also the participants were able to have students explain their thought process. However, the level of participation in professional development varied by each participant. Participant 1 attended the district wide curriculum on a regular basis and invited the math coach in to model and provide feedback. Participant 6 has not attended professional development but she has observed other teachers who have attended math studio. Participant 2 has attended professional development in the past that focused on math, but she explained that she has not been to a professional development program in years.

This qualitative case study found that the participants who reported low self-efficacy had the ability to demonstrate strategies to challenge students to problem solve, justify solutions and have students explain their thought process. In contrast, the participants who reported high self-efficacy lacked the skills to challenge students to justify solutions and have students explain their thought process. However, these participants were able to challenge students to problem solve. In conclusion, the analysis of the data suggests that there was a relationship between professional development and how various types of professional development impact both self-efficacy and instructional strategies. Further, a relationship between the reported self-efficacy and the instructional strategies was identified.

Since there is a potential relationship between professional development, self-efficacy and instruction in mathematical strategies it would be advantageous for all participants to attend professional development. However, math studio is not offered to every school or to every teacher. Some schools in the Albany school district participate in math studio and some other schools participate in English Language Art (ELA) studio. According to some of the participants in this study, the reason for the difference in program offering is because each school has a choice to participate in Math Studio or ELA studio.

Even though all the participants are not part of math studio, the math coach is available to them in all schools. The participants decide whether to invite the math coach into their classroom. Some participants have invited the math coach into their classrooms, while other participants have not invited the math coach into their class. It was not evident in my data why some chose to invite the math coach in and why some participants chose not to invite the coach in their classroom.

Although teachers don't have a choice in which studio will be offered in their school, they do have a choice to invite the math coach into their classroom. Some participants explained that having the math coach model lessons and provide constructive feedback on math lessons they taught were valuable in supporting their self-efficacy and instruction in mathematical strategies. It would be beneficial to invite the math coach into their classroom to model lessons and provide feedback on observed lessons.

## Implications for Social Change

This study found valuable information that will lead to meaningful professional learning opportunities for teachers in the local school district. The results of this study identified potential relationships between professional development and the impact on both self-efficacy and instructional strategies specific to justifying solutions in mathematics. Development and implementation of professional development programs that focus on justifying solutions in mathematics can have a positive impact on the teachers' instructional strategies. The results of this study can be used as supportive academic research in pursuing a direction in professional development that fosters this change. Further development of professional development programs that incorporate this strategy will ultimately effect positive social change. This will be accomplished by increasing the self-efficacy of teachers and positively impacting the instructional approaches they incorporate in their mathematic lessons.

As supported by this research, professional development tends to positively impact the self-efficacy of teachers. This in turn impacts the instructional strategies they incorporate in their mathematics lessons. An improvement in this chain of events ultimately impacts the quality of education and the ability for these students to develop academically. This study offers an

opportunity to positively impact this process by supporting the development of teachers and their instruction in mathematical approaches.

## Recommendations for Action

This study revealed potential connections between professional development and kindergarten teachers' self-efficacy in teaching mathematics. Potential connections were also identified between professional development and the teachers' ability to develop within their students, problem-solving skills and the ability to justify solutions. This information may be valuable for school administers, kindergarten teachers, parents, professors and other relevant stakeholders within the early childhood field. To maximize the impact of these results in practice both school administrators and the kindergarten teachers need to be exposed to these findings.

I intend to incorporate two methods of distribution for this information. The first step in this process will be to compose an abbreviated report that highlights the details and findings of this study. This report will be disseminated directly to the superintendent of the Albany school district and the principals and kindergarten teachers of each of the participating schools. This will ensure that the information reaches the local school district quickly and appropriately. The second phase of the dissemination process will be the development of a journal article in a peer reviewed academic journal. This will both build credibility to these findings as well as spread the message to a much wider and potentially influential audience.

## Recommendations for Further Study

This study was designed to investigate teachers at the pre-kindergarten and kindergarten grade levels. Although pre-kindergarten teachers were recruited for this study none of them volunteered to participate in this study. This narrowed the scope of the study to only kindergarten

teachers. Therefore, it is highly recommended that further research targeting pre-kindergarten teachers be conducted in the future.

The background investigation including the literature review found that nearly all studies that investigate self-efficacy theory incorporate a quantitative method. This study deviated from this method and incorporated a qualitative study. Through this qualitative investigation discrepancies were identified between Badura's (1997) findings. In his study, Bandura (1997) explained that teachers with high self-efficacy provide opportunities of in-depth learning. In my study I found that the teachers who reported high self-efficacy did not provide opportunities for in-depth learning. It is strongly recommended that further studies examine this discrepancy through qualitative and mixed methods approaches.

The narrow scope of this study does not lend itself to long-term implications of the connections between professional development, teachers' self-efficacy and the instruction in mathematical strategies that takes place in early childhood education. A longitudinal study that thoroughly investigates this area of research from pre-kindergarten to third grade, including the third grade mathematical testing, would provide a richer understanding.

There was one topic that arose during the interviews that was of particular interest but was not initially incorporated into this research plan. Some of the participants explained that participating in district professional development and observing a teacher who attended math studio increased their self-efficacy and provided mathematical strategies to challenge students to problem solve and justify solutions. Further discussions about whether or not the use of a math coach, the use of math studio, or the observation of a teacher who attended math studio was more

effective in having an impact on self-efficacy and instructional strategies would be beneficial. Future researchers would benefit from incorporating this content into their studies.

## Summary

The research process enabled me to conduct a scholarly inquiry into an area of personal and professional interest. This provided me the opportunity to investigate an area of early childhood education that I believe is fundamental to the educational development of young students. Throughout my academic and professional career I have developed a belief in the importance of early development of critical thinking skills.

The incorporation of a scientific method in the study of educational process has allowed me the opportunity to explore this topic in a manner that has an elevated level of credibility. My professional career has centered on effecting positive social change within the Albany New York School system. This study adds to this pursuit by incorporating academic research into a form that is readily accessible and easily incorporated into the current professional development programs being utilized. This study provides support for the further development of programs that focus on problem solving and justifying solutions. Further, as an assistant professor I have the opportunity to design course work related to this topic that will prepare future educators to teach students' how to solve problems and justify solutions in mathematics. By incorporating this study's findings into my college level curriculum I am able to spread this valuable message further then the local school district.

As I reflect on my experiences in the Albany school district, what resonated with me the most was the belief of many educators that young students in early childhood are incapable of

developing critical thinking skills. I decided to investigate prekindergarten and kindergarten teachers' self-efficacy in challenging students to problem solve and justify solutions.

I had preconceived notions that district professional development would have a greater impact on instruction in mathematical strategies than this study indicated. Prior to this study, I believed that if educators only participated in rigorous professional development focused on problem solving and justifying solutions, then their instruction in mathematical strategies would strengthen. However, what I found during this study was professional development alone, does not necessarily have the greatest impact on how teachers approach problem solving and justifying solutions. Both professional development in conjunction with practical experience in teaching math contribute to teachers' ability to challenge students to problem solve and justify solutions.

Prior to conducting this research, I had a limited understanding of teacher's self-efficacy as it applies to instruction in mathematics. The knowledge and deeper insight gained from this experience has been rewarding. What was particularly interesting in these results was that the teachers who reported low self-efficacy had the most effective instruction in mathematical strategies in challenging students to problem solve and justify solutions.

This study investigated a targeted area of teacher's instruction in mathematics. As a single component of the broader issue of academic development, this can be of interest to educational leaders. Professional development programs are currently available and are already incorporated into the continuing educational practices of public school teachers. A better utilization of these programs can elevate the quality of education being provided to our early childhood students. Within the larger educational context any increases in the quality of

mathematical inquiry skills at the early childhood level will assist in fostering a better academic career for these students.

References

Abrami, P., Bernard, R., Borokhovski, E., Wade, A., Surkes, A., Tamim, R., & Zhang, D. (2008). Instructional interventions affecting critical thinking skills and dispositions: A state 1 meta-analysis. *Review of Educational Research, 78*(4), 1102-1134.

Albany School District (2014). Strategic Plan: 2020 Vision Draft. Retrieved from http://albanyschools.org

Ashton, P. (1984). Teacher efficacy: A motivational paradigm for effective teacher education. *Journal of Teacher Education*, *35*(5), 28-32. doi:10.1177/002248718403500507

Ashton, P. T., & Webb, R. B. (1986). *Making a difference: Teacher efficacy and student achievement*. New York, NY: Longman.

Bandura, A., (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191-215.

Bandura, A. (1986). *Social foundations of thought and action*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist*, *28*(2), 117–148. doi:10.1207/s15326985ep2802_3

Bandura, A. (1997). *Self-efficacy. The exercise of control*. New York, NY: W.H. Freeman and Company.

Bandura, A. (2000). Exercise of human agency through collective efficacy. *Current Directions in Psychological Science, 9,* 75-78.

Bates, A., Latham, N., & Kim, J. (2013). Do I have to teach math? Early childhood pre-service teachers' fears of teaching mathematics. *IUMPST: The Journal, 5*, 1-10.

Bhattacharyya, S., Junot, M., & Clark, H. (2013). Can you hear us? Voices raised against standardized testing by novice teachers. *Creative Education, 4*(10), 633-639.

Bleiberg, J., & West, D. (2014). *In defense of the Common Core Standards.* Center for Technology Innovation. Retrieved from www.brookings.edu

Bogdan, R. C. & Biklen, S. K. (2007). *Qualitative research for education: An introduction to theories and methods* (5th ed.). Boston, MA: Allyn & Bacon.

Bouchard, C., Bigras, N., Cantin, G., Coutu, S., Blain-Brie`re, B., Eryasa, J., Charron, A., & Brunson, L. (2010). Early childhood educators' use of language-support practices with 4-year-old children in childcare centers. *Early Childhood Education*, *37*(5), 371-379. doi:10.1007/s10643-009-0355-7

Boyd, W., Foster, A., Smith, J., & Boyd, W. (2014). Feeling good about teaching mathematics: Addressing anxiety amongst pre-service teachers. *Creative Education, 5*, 207-217. doi:http://dx.doi.org/10.4236/ce.2014.54030

Bruer, J. (1998). The brain and child development. *Public Health Reports, 113*(5), 388-397.

Case, R. (2005). Moving critical thinking to the main stage. *Education Canada, 45*(2), 45-49.

Chen, J. Q., & McCray, J. (2013). A survey study of early childhood teachers' beliefs and confidence about teaching early math. *Early Math Collaborative Working Paper* No. 2013-2. Retrieved from http://earlymath.erikson.edu

Clements, D. H., & Conference Working Group. (2004). Part 1: Major themes and recommendations. In D. H. Clements, J. Sarama, & A.-M. DiBiase (Eds.), *Engaging young children in mathematics: Standards for early childhood mathematics education*, (pp. 7–76). Mahwah, NJ: Lawrence Erlbaum.

Clements, H., Baroody, A., & Sarama, J. (2013a). *Background research on early mathematics.* Washington, DC: National Governors Association. doi:10.14221/ajte.2011v36n8.5

Clements, H., Baroody, A. & Sarama, J. (2013b). Math in the early years. *Education Commission of the States, 14*(5), 1-17.

Common Core State Standards Initiative. (2015). About the Common Core state standards. Retrieved from http://www.corestandards.org/about-the-standards/

Copple, C., & Bredekamp, S. (2009). *Developmentally appropriate practice in early childhood programs serving children from birth through age 8*. Washington, DC: NAEYC.

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (Laureate custom ed.). Boston, MA: Pearson Education.

Creswell, J. (2013). *Qualitative inquiry & research design. Choosing among five approaches.* Thousand Oaks, CA: Sage Publications.

Critical Thinking Community. (1994). Defining critical thinking. Retrieved from http://www.criticalthinking.org/pages/defining-critical-thinking/766

Duckworth, A. L., Quinn, P. D., & Tsukayama, E. (2012). What "No Child Left Behind" leaves behind: The roles of IQ and self-control in predicting standardized achievement test scores and report card grades. *Journal of Educational Psychology, 104*(2), 439-451. Retrieved from ERIC database.

Education First. (2014). *Common Core State Standards & the transformation of professional development. Executive Summary*. Retrieved from www.education-first.com

EngageNY (2015). *New York State P-12 Common Core Learning Standards*. Retrieved from

https://www.engageny.org/resource/new-york-state-p-12-common-core-learning-standards.

Epstein, A. (2008). An early start on thinking. *Educational Leadership, 65*(5), 38-42.

Garet, S., Porter, A., Desimone, L., Birman, B., & Yoon, K. (2009). What makes a professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*(4), 915-945.

Gawthrop, J. (2014). *Measuring student achievement: A study of standardized testing and its effect on student learning.* Retrieved from http://my.jessup.edu

Gibson S., & Dembo, H. (1984). Teacher efficacy: A construct validation. *Journal of Educational Psychology*, *76*(4), 569-582. doi:http://dx.doi.org/10.1037/0022-0663.76.4.569

Gojak, L. (2013). *What's all this talk about rigor?* Retrieved from http://www.nctm.org

Gregory, H., & Chapman, C. (2013). *Differentiated instructional strategies.* Thousand Oaks, CA: Sage Publications.

Gresham, G. (2008). Mathematics anxiety and mathematics teacher efficacy in elementary pre-service teachers. *Teaching Education, 19*, 171-184. doi:10.1080/10476210802250133

Gresham, G. (2009). An examination of mathematics teacher efficacy and mathematics anxiety in elementary pre-service teachers. *Journal of Classroom Interaction, 44*(2), 22–34.

Haciomeroglu, G. (2013). Mathematics anxiety and mathematical beliefs: What is the relationship in elementary pre-service teachers? *Issues in the Undergraduate Mathematics Preparation of School Teachers: The Journal, 5,* 1-9.

Halpern, D. (1998). Teaching critical thinking for transfer across domains: Dispositions, skills, structure training, and metacognitive monitoring. *American Psychologist, 53*(4), 449-455.

Hightower, A., Delgado, R., Lloyd, S., Wittenstein, R., Sellers, K., & Swanson, C. (2011). *Improving student learning by supporting teacher quality*. Bethesda, MD: Editorial Projects in Education, Inc.

Hursh, D. (2011). Explaining Obama: The continuation of free market policies in education and the economy. *Journal of Industry and Action in Education, 4*(1), 31-47, Retrieved from ERIC database.

Iaquinta, T. (2014). General education teachers' perceptions of self-efficacy to teach in the inclusive classroom. (Doctoral Dissertation) Available from ProQuest Dissertations and Theses Database, (UMI No. 3633491).

Incikabi, L. (2013). Teacher candidates' efficacy beliefs in mathematics: Play-generated curriculum instruction. *Eurasia Journal of Mathematics, Science and Technology Education, 9*(2), 167-176. doi:10.1080/09523987.2012.741198

Johnson, B., & VanderSandt, S. (2011). "Math makes me sweat." The impact of pre-service courses on mathematics anxiety. *Issues in the Undergraduate Preparation of School Teachers: The Journal, 5,* 1-8.

Lai, E. (2011). *Critical thinking: A literature review*. Pearson Research Reports, 6.

Lee, J., & Ginsburg, H. (2009). *Early childhood teachers' misconceptions about mathematics education for young children in the United States.* Retrieved from http://www.learningdomain.com/medhome3/ececurriculum/teachers.misconcep.maths.pdf

Ljubetic, M. (2012). New competences for the pre-school teacher. A successful response to the challenges of the 21st century. *World Journal of Education, 2*(1), 82-90.

Lodico, M., Spaulding, D., & Voegtle, K. (2010). *Methods in educational research: From theory to practice* (Laureate Education, Inc., custom ed.). San Francisco, CA: John Wiley & Sons.

Mathis, W. J. (2010). The ‘‘common core’’ standards initiative: An effective reform tool? *Great Lakes Center for Education Research and Practice*, 1-25.

Maxwell, J. (2012). *Qualitative research design: An interactive approach*. Thousand Oaks, CA: Sage Publications.

McLaughlin, M., & Overturf, B. J. (2012). The common core insights into the K-5 standards. *The Reading Teacher, 66*(2), 153-164. doi:10.1002/trtr.01115

Merriam, S. (1998). *Qualitative research and case study applications in education*. San Francisco, CA: John Wiley & Sons, Inc.

Miller, O., Strier, R., & Pessach, L. (2009). Power relations in qualitative research. *Qualitative Health Research, 19*(2), 279-289.

Mongeau, L. (2014). EdSource. Common core standards bring dramatic changes to elementary school math. Retrieved from http://edsource.org/2014/common-core-standards-bring-dramatic-changes-to-elementary-school-math-2/63665#.VVAJ12C-oRk

Moore, B., & Stanley, T. (2010). *Critical thinking and formative assessments: Increasing the rigor in your classroom*. Larchmont, NY: Eye on Education, Inc.

Munoz, R. (2011). Make it or break it: High school testing pros and cons. Retrieved from

http://www.education.com/print/high-stakes-testing-pros-cons.

National Association for the Education of Young Children. (NAEYC) (2010). 2010 NAEYC standards for initial & advanced early childhood professional preparation programs. *NAEYC Standards.*

NAEYC (2010). *Early childhood mathematics: Promoting good beginnings*. Position Statement. Washington, DC: NAEYC.

NAEYC & National Association of Early Childhood Specialists in State Departments of Education (NAECS/SDE). (2003). *Early childhood curriculum, assessment, and program evaluation: Building an effective, accountable system in programs for children birth through age 8*. Joint Position Statement. Washington, DC: NAEYC.

NAEYC (2009). *Developmentally appropriate practice in early childhood programs.* Serving children from birth through Age 8. Position Statement. Washington, DC: NAEYC.

National Center for Education Statistics. (2015). *National assessment of educational progress.* Retrieved from http://nces.ed.gov/nationsreportcard/

National Council of Teachers of Mathematics. (NCTM) (2006). *Curriculum focal points for pre-kindergarten through grade 8 mathematics - A quest for coherence*. Reston, VA: Author.

NCTM (2011). *High expectations*. NCTM position statement. Retrieved from http://www.nctm.org/Standards-and-Positions/Position-Statements/High-Expectations/

NCTM (2013). *Mathematics in early childhood learning*. NCTM Position statement. Retrieved from http://www.nctm.org/Standards-and-Positions/Position-Statements/Mathematics-in-Early-Childhood-Learning/

NCTM (2015). *Standards overview.* Retrieved from http://www.nctm.org/standards/content.aspx?id=26798

NCTM & NAEYC (2010). *Early childhood mathematics: promoting good beginnings.* Retrieved from https://oldweb.naeyc.org/about/positions/psmath.asp

National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common Core State Standards.* Washington, DC: Authors.

National Institute for Early Education Research (2015). *What is developmentally appropriate math?* Retrieved from http://preschoolmatters.org/2015/04/15/what-is-developmentally-appropriate-math/

National Mathematics Advisory Panel (2008). *Foundations for success: The final report of the National Mathematics Advisory Panel.* U.S. Department of Education, Office of Planning, Evaluation and Policy Development, Washington D.C.

New York State Education Department. (2010). *Common Core background.* Retrieved from p12.nysed.gov

New York State Education Department. (2014). *English language arts (ELA) and mathematic assessment results.* Retrieved from http://www.p12.nysed.gov/irs/ela-math/Archive.html

New York State Education Department. (2015). *Information and reporting services.* Retrieved from http://www.p12.nysed.gov/irs/pressRelease/20140814/home.html

Organisation for Economic Co-operation and Development (OECD). (2014). *PISA 2012 results in focus. What 15-year-olds know and what they can do with what they know*. Paris: OECD

Organisation for Economic Co-operation and Development (OECD). (2015). *Programme for*

*International Student Assessment* (PISA). Retrieved from http://www.oecd.org/pisa/aboutpisa/

Paige, D., Sizemore, J., & Neace, W. (2013). Working inside the box: Exploring the relationship between student engagement and cognitive rigor. *NASSP Bulletin, 97*(2), 105-123. doi:10.1177/0192636512473505

Partnership for the 21st Century. (2014). *Costa: Thinking critically about critical thinking.* Retrieved from http://www.p21.org/news-events/p21blog/1409-costa-thinking-critically-about-critical-thinking

Partnership for the 21st Century. (2009). *P21 Framework definitions*. Retrieved from http://www.p21.org/storage/documents/P21_Framework_Definitions.pdf

Patton, M. (2014). *Qualitative research & evaluation methods.* Thousand Oaks, CA: Sage Publications.

Parents for Public Schools. (2015). *Pros and cons. Common Core State Standards. Retrieved from parents4publicschools.org*

QSR International. (2015). *NVivo for Mac.* Retrieved from http://www.qsrinternational.com/products_nvivo-mac.aspx

Salmon, A. (2008). Promoting a culture of thinking in the young child. *Early Childhood Education, 35*, 457-461. doi:10.1007/s10643-007-0227-y

Schiller, P. (2010). Early brain development research review and update. *Exchange,* 26-30.

Schmidt, W. & Burroughs, N. (2013). Springing to life: How greater educational equality could grow from the Common Core Mathematics Standards. *American Educator,* 1-8.

Seidman, I. (2012). *Interviewing as qualitative research.* New York: Teachers College.

Seker, P., & Alisinanoglu, F. (2015). A survey of the effects of preschool teachers' beliefs and self-efficacy towards mathematics education and their demographic features on 48-60 month old preschool children mathematic skills. *Creative Education*, 6, 405-414. doi:doi.org/10.4236/ce.2015.63040

Snyder, L., & Snyder, M. (2008). Teaching critical thinking and problem solving skills. *The Delta Pi Epsilon Journal, 50*(2), 90-99.

Soodak, L C., & Podell, D.M. (1996). Teaching efficacy: Toward the understanding of a multi-faceted construct. *Teaching and Teacher Education, 12*, 401–412. doi:10.1016/0742-051X(95)00047-N

Starr, J. D. (2012). A lack of depth: One pre-service teacher's experiences in a post 106 NCLB world. *Social Studies, 103*(6), 241-246.

Swars, S. (2005). Examining perceptions of mathematics teaching effectiveness among elementary preservice teachers with differing levels of mathematics teacher efficacy. *Journal of Instructional Psychology, 32*(2), 139-146.

Thames, M., & Ball, D. (2013). Making progress in U.S. mathematics education: Lessons learned-past, present, and future. K.R. Leatham (Ed.), *Vital Directions for Mathematics Education Research.* New York: Springer Science and Business. doi:10.1007/978-1-4614-6977-3_2

Tomlinson, C. (2003). *Fulfilling the promise of the differentiated classroom: Strategies and tools for responsive teaching*. Alexandria, VA: Association for Supervision and Curriculum Development.

Torre, A., Doctors, J., Hussain, M., Mulkey, M., Wat, A., & Young, M. (2011). Transforming public education: Pathway to a Pre-K-12 future. *The Pew Center of the States.* Retrieved from http://www.pewstates.org

Tschannen-Moran, M., & Woolfolk Hoy, A. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and Teacher Education, 17*, 783-805. doi:10.1016/S07

Tsamir, P., & Tirosh, D. (2009). Affect, subject matter knowledge and pedagogical content knowledge: The case of a kindergarten teacher. *Beliefs and Attitudes in Mathematics Education*, 19-32.

Warwick, J. (2008). Mathematical self-efficacy and student engagement in the mathematics classroom. *MSOR Connections, 8*(3), 31-37. doi:10.11120/msor.2008.08030031

Warnick, B., & Inch, E. (2009). *Critical thinking and communication.* New York: Macmillan.

Wilkins, J. (2008). The relationship among elementary teachers' content knowledge, attitudes, beliefs, and practices. *Journal of Math Teacher Education, 11*, 139-164. doi:10.1007/s10857-007-9068-2

William, D. (2010). Standardized testing and school accountability. *Educational Psychologist, 45*(2), 107-122. doi:10.1080/00461521003703060.

Yesil-Dagli, U., Lake, V., & Jones, I. (2011). Pre-service teachers' beliefs about mathematics and science content and teaching. *Journal of Research in Education, 21*(2), 32-48.

Yin, R. (2013). *Case study research: Design and method.* Thousand Oaks, CA: Sage.

# Appendix A: Interview Protocol Guide

Interview Guide Project: Instructional Practices and Self-Efficacy of Elementary Mathematics Teachers

Time of Interview:

Date:

Place

Interviewer:

Interviewee:

Position of the Interviewee:

Questions:

# Appendix B: Interview Questions

Background/Knowledge

1. Describe the position you currently hold at your school.
2. Describe your teaching experience including grade level(s) taught and years of experience.
3. How many years have you been working as a prekindergarten/kindergarten teacher?

Experience and Behavior

1. Tell me about a typical math lesson that you implement during your math instruction block.
2. Tell me about a time when you taught problem solving.
3. What teaching strategies do you use to teach math that challenges students to problem solve and justify their solutions?
4. How do you decide which professional development workshops to attend?

Opinion and Value

1. How would you define critical thinking?
2. In early childhood education what does developing critical thinking skills mean to you?
3. How would you describe your self-confidence in regards to your math instructional practices?
4. How would you describe your confidence in teaching mathematics with a focus on problem solving and justifying solutions?
5. What mathematical instructional strategies are you most confident in using to engage students in challenging students in problem solving and justify solutions? Why?

6. What mathematical instructional strategies are you least confident in using to engage students in problem solving and justify solutions? Why?
7. What makes a professional development workshop engaging and interesting?
8. What types of professional development workshops would you like the district to offer?
9. Which professional development workshops do you find effective in supporting teaching math that challenges students to solve problems and justify their solutions?

Feeling

1. How do you feel about teaching math in prekindergarten/kindergarten?
2. How do you feel about teaching math that challenges students to solve problems and justify their solutions?
3. How do you feel about teaching math with a focus on critical thinking?

Knowledge

1. What mathematics professional development programs have you attended?
2. What mathematical curriculum is currently being used in your district?
3. What training have you had on integrating critical thinking in your mathematical instruction?
4. What training have you had on the Math Common Core Standards?

# Appendix C: Observation Protocol Guide

Date:

Time:

| Length of Activity: | |
|---|---|
| Descriptive Notes | Reflective Notes |
| | |
| | |
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