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Impact of the Mathematics Curriculum Coach on Teacher Instructional Practice and Teacher Self-Efficacy

Alison Rollins Syverson

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By
Alison Rollins Syverson

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Approval Page

This dissertation was submitted by Alison Rollins Syverson under the direction of the persons listed below. It was submitted to the Gardner-Webb University School of Education and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Gardner-Webb University.

Jenny Sabin, Ed.D. Committee Chair	Date
Jim Palermo, Ed.D. Committee Member	Date
Ross Renfrow, Ed.D. Committee Member	Date
Jeffrey Rogers, Ph.D. Dean of the Gayle Bolt Price School of Graduate Studies	Date

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Abstract

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This mixed-methods study sought to explore the impact the role a mathematics curriculum coach has on teacher efficacy and instructional practice.

School systems across the country are being asked to do more with less money. At the same time, districts are faced with mathematics standards that require a new approach to instruction. In response to these issues, school districts are choosing to implement the role of a mathematics curriculum coach. As a result, the question is raised, "are the funds utilized for math coaches being used effectively?" This mixed-methods study compared two schools of similar makeup. School A employs a math curriculum coach, while School B employs a general curriculum coach. Through the use of a survey (MTEBI), curriculum coach journaling, focus groups, and one-on-one interviews, this study sought to answer three research questions: (a) What is the impact of the use of a math curriculum coach on teacher instructional practices in the area of math; (b) What is the impact of the use of a math curriculum coach on teacher perceptions of their instructional practice; and (c) What is the impact of the use of a math curriculum coach on teacher sense of self-efficacy? The survey was administered to all teachers at both schools with an overall response rate of 63.6%. The focus groups and interviews were a small random sample of teachers at each school who provided an in-depth view of their perceptions regarding the impact of the coaches on their instructional practice and self-efficacy as related to mathematics. The teachers had high levels of self-efficacy when teaching math and high outcome expectancy. These measures did not change over the period of the study. This study found that the math curriculum coach did have an impact on teacher instructional practices.

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Chapter 1: Introduction

This study investigated the impact of a mathematics coach on teacher instructional practices and self-efficacy. In Chapter 1, the context of the problem, situational background, and demographic characteristics of the focus schools are discussed. Chapter 1 provides a description of the involved schools and the questions to be considered.

Statement of the Problem

As school systems across the country pour money into math curriculum coaches, the question arises, “are the dollars spent on coaches being used effectively?” Hall and Simeral (2008) indicated that the implementation of curriculum coaches in education is a hot trend. One school district pays curriculum coaches an average of $18,000 more than a typical classroom teacher (Chilton, 2010). In this same southwestern school district, $4.2 million of the $19 million budget is spent on ancillary staff, which includes the coaches (Ezarik, 2002). Likewise, one midwest state is receiving $26.6 million in federal funding to assist poor performing schools. Of these funds, $9.4 million is being spent on instructional and leadership coaches (Brown, 2012). Also putting millions of dollars into coaching positions is a northeast state which allots $7.1 million to this position (Hall & Simeral, 2008).

School spending budgets are shrinking (Ezarik, 2002). In some cases, the budgets are being reduced in favor of vouchers and charter schools (Gordon, 2013). Other districts are cutting budgets in order to save spending reserves (Thomas, 2016). In one case, the district stated that cutting curriculum coaches would save nearly $700,000.

As school districts and state governing bodies must use their budgets effectively, evaluation of the curriculum coach positions must occur (Ezarik, 2002; Gordon, 2013).

The evaluations ensure that coaching programs are effective and worth the cost (Ezarik, 2002). This process also seeks to ensure that the role is properly defined (Hall & Simeral, 2008). As Knight (2014) indicated, ineffective coaching is a poor use of budgetary funds.

As a result, this dissertation study examined the impact of a math curriculum coach on teacher instructional practices and teacher self-efficacy. Careful consideration was given to the expectations of the role of math coach and the impact the coach has on instructional practices and teacher self-efficacy. A comparison was drawn with a school that has a general curriculum coach.

Demographic, geographic, and statistical data. This study involved two elementary schools within two different school districts in one southeastern state.

This comparative study involved one school, School A in District A, that utilizes a math curriculum coach and another school, School B in District B, that has a curriculum coach position that is designated for the general curriculum. School A is located in a small town that sits on the edge of a larger urban area and is a Title I school. The student population draws from families involved in retail industry and agriculture as well as those who commute to employment outside of the area. This school has a large Hispanic population.

School B is located within 85 miles of School A. Both towns have their own law enforcement agencies. As with School A, School B has a large Limited English Proficient population and is a Title I school. This fact makes communication with parent stakeholders difficult and also means that many of the children are the first in their family to learn English. One difference between the two schools is School B does not provide dual language classes. The population feeding into this school is very transient, and total

enrollment has decreased over the last 3 years. A review of Table 1 shows the ethnic makeup of these two schools.

Table 1

Ethnic Makeup Comparisons of Two Participating Schools

	Total Enrollment	Ethnicity				EDS
		% of White Students	% of African-American Student	% of Hispanic Students	% of Other Ethnicities	% of EDS (number)
School A	536	20% (107)	40% (214)	32% (172)	8% (43)	69% (368)
School B	515	28% (145)	28% (144)	40% (206)	4% (21)	79% (407)

Note. *E*DS=Economically Disadvantaged Students.

While similarities exist between the two schools, Table 1 highlights the differences that occur in the demographics of the populations. School A has a larger student body with a lower percentage of students who are economically disadvantaged, but both schools have more than two thirds of the population qualifying for this criterion. In addition, the table shows that both schools have a majority of students who are minority ethnicities. School B has 8% more White students and 8% more Hispanic students enrolled, while School A has 12% more Black students. As can be seen in the table, more than 50% of the students come from a minority ethnicity. Table 2 shows the general characteristics of the school as related to organization.

Table 2

Characteristic Comparisons of Two Participating Schools

	Grade Span	Number of Classroom Teachers	Average Class Size	Location
School A	PreK-5th	26	24	Medium-size Town
School B	K-5th	29	16	Small Town

The average class size is 24 students at School A and 16 students at School B. School A provides a preschool program while School B enrolls students in kindergarten through Grade 5. Table 2 also shows that the two schools are located in different size towns.

Table 3 shows the 4-year trend of the overall end-of-grade test data for Grades 3-5 at each school in reading and mathematics beginning with the 2014-2015 school year. School performance is compared to the district and state results as well.

Table 3

Four-Year Trend of Percentage of Student Scores in Reading and Math at or Above Grade Level

	2014-2015		2013-2014		2012-2013		2011-2012	
	Reading	Math	Reading	Math	Reading	Math	Reading	Math
School A	39.7%	29.0%	40.0%	35.0%	28.0%	29.5%	50.8%	74.7%
School B	58.8%	65.7%	50.2%	59.0%	29.6%	40.1%	64.2%	89.4%
State	56.3%	52.2%	56.3%	51.1%	43.9%	42.3%	71.2%	82.8%

When looking at this 4-year trend in data, consideration must be given to the fact that 2011-2012 was the last year of the old curriculum, which did not emphasize critical thinking and conceptual understanding to the same extent as the curriculum implemented and tested during the 2012-2013 school year. School A showed test scores below the

state average in reading. The school's math scores also were lower than the state's average. In 2011-2012, School A's math scores were below the state average as well. School B exceeded the state overall math averages for percent proficient during the 2011-2012 school year. Once the new math curriculum, Common Core State Standards, was implemented in 2012-2013, Schools A and B performed much worse than the state average. With each year since 2012-2013, School B has shown a steady increase in its scores. School A showed an increase in its math scores in 2013-2014, but the scores decreased again in 2014-2015. The initial decrease in scores aligns with the implementation dip often demonstrated in the change process (Hall & Hord, 2011).

As the test data show, the students at these two schools have struggled with mathematics content. Approximately 70% of the students enrolled in School A and 34% of the students in School B continue to not meet proficiency in mathematics. Careful consideration of the test data in Table 3 seems to indicate that literacy has been a focus of instruction. Upon examination of the test data, math scores decreased by approximately 40-60% after the implementation of Common Core State Standards. At the same time, the reading scores dipped only 20-30%. The dip aligns with that experienced by the state. The Read to Achieve initiative in the state in 2012 required that all students be reading at grade level by the end of third grade. Students who fail to achieve grade-level reading must receive intensive interventions such as summer reading camp or retention in third grade (Excellent Public Schools Act, 2012). The implementation of this initiative should be acknowledged. No such initiative exists relating to math proficiency.

Another data point used to measure how well a school is educating its students is the Annual Measureable Objectives (AMO) information. The federal government measures each school based on the ability to close the achievement gap among categories

or subgroups of the student population with a goal of decreasing the percentage of nonproficient students by 50% within a 6-year period (North Carolina Department of Public Instruction [NCDPI] Accountability Services, 2012). According to NCDPI Accountability Services (2012), a school must have at least 30 students enrolled who are identified in a category (such as special education) in order to have a subgroup. Table 4 shows the number of AMOs met for each school over the same 4-year period as the previously referenced achievement data.

Table 4

AMO – 4-Year Data Trend

School	School Year	AMO Met	AMO Assigned	Percentage
School A	2014-2015	14	27	51.9%
	2013-2014	19	29	65.5%
	2012-2013	21	27	77.8%
	2011-2012	17	21	80.9%
School B	2014-2015	32	35	91.4%
	2013-2014	36	38	94.7%
	2012-2013	26	29	89.7%
	2011-2012	23	25	92%

North Carolina Schools Report Card (2015).

Over the 4-year period shown in the table, School A has experienced a decline in the number of AMOs met, but School B exceeded the previous high from 2011-2012 in 2013-2014. Each school has also seen a fluctuation in the number of AMOs to meet due to changes in the demographic and socioeconomic status of the population feeding into the school. The data also indicate that School A has seen a steady drop in the percentage of AMOs met. The dip from the 2012-2013 school year to the 2013-2014 school year falls in line with the adoption of the Common Core State Standards. Hall and Hord (2011) explained that change is a process that does not occur overnight. True change takes 3-5 years to implement (Hall & Hord, 2011). In reviewing the AMO data, while

considering Hall's and Hord's work, the expectation of improvement in the AMO data is not unreasonable.

The formal job description of curriculum coach is defined as instructional coach (C. Turner, personal communication, June 27, 2016). The role of coach includes the following responsibilities: maintain the confidentiality of student and teacher information; effectively analyze and use student data to address teaching and learning needs of the school; assist teachers with research-based instruction by planning, leading, and/or modeling high-quality instruction; actively participate in Professional Learning Communities; observe teachers in a way that provides feedback to inform instructional practice, minus evaluative measure; and display effective leadership in a variety of situations (C. Turner, personal communication, June 27, 2016). Coaches should not be designated as testing coordinators, assessment administrators, daily teachers, substitutes, or additional eyes for the administration. These roles should be assigned to other teachers (C. Turner, personal communication, June 27, 2016).

Historical background. As the Common Core State Standards were implemented, the National Council of Teachers of Mathematics (NCTM, 2013) indicated that changes to curriculum and expectations result in the need to examine instructional practice and student achievement. In the two focus schools for this study, the change in the curriculum to conceptual understanding has created opportunities for altering the approach to teaching. This new philosophy in mathematics instruction is different from the way most teachers experienced math as students and are comfortable teaching the subject (Green, 2014). As part of a constructivist approach, teachers are not focusing on computation rules and procedures. Instead, teachers present problems and the students develop their own approaches and must then explain their thinking and strategy for

solving the problem (Hall & Hord, 2011). Previously students have been expected to use standard algorithms and memorize basic facts. Currently, as students are expected to be able to articulate their thinking and use a variety of strategies to solve problems, teachers are having to shift the way they teach and deepen their understanding of mathematical concepts. Green (2014) explained this process by saying, "Teachers primarily learn to teach by recalling their memories of having been taught, about 13,000 hours of instruction during a typical childhood – a problem since their education wasn't very good" (para. 30).

Although the new standards emphasize student understanding, Hall and Hord (2011) indicated that standardized test scores may not improve over the first 2 years of implementation of the curriculum. Although many view test scores as being extremely important, the fact that students will possess better math knowledge through instruction using conceptual understanding is important. This ideal is reflected in NCTM's (1989) position that teachers "knowing" mathematics does not guarantee they are able to teach the mathematics so students develop a deep understanding of the concepts in order to understand and deal with it in powerful ways. To bring about this change, professional learning needs to take place that will build teacher knowledge of the subject and ways to support student learning and understanding (Green, 2014). One method of addressing the changes needed in instructional practice is the use of mathematics curriculum coaches (Costa & Garmston, 1994; Darling-Hammond & McLaughlin, 1995; Garmston & Wellman, 1999). Unlike other areas of educational research, a large body of research does not yet exist regarding this approach and requires further study to determine the benefits (Poglinco et al., 2003). As a result, this study examined the impact of the role of a mathematics curriculum coach on instructional practices and teacher self-efficacy.

From the colonial era to the 1900s. Just as the physical landscape has changed over the years, the educational landscape regarding mathematics instruction has changed. During the colonial era, schooling focused on instruction that promoted spiritual understanding. At this time, rudimentary mathematics was a small portion of the curriculum of the day (Marsh & Willis, 2007). In 1642, when Harvard University opened, most schools sought to prepare students for this institute of higher learning. At this time, instruction continued to focus on much of the curriculum of the colonial era, but the mathematics curriculum did expand to include arithmetic and geometry (Marsh & Willis, 2007). In 1749, Benjamin Franklin suggested the curriculum, which included mathematics, be further expanded to include active inquiry and field trips. His recommendation did not indicate what subjects would receive emphasis (Marsh & Willis, 2007). During the 19th century, the Franklin academies were further developed. Religious training declined in importance as a more secular approach was implemented. As part of this movement, algebra was added to the mathematical concepts of arithmetic and geometry (Marsh & Willis, 2007).

Late in the 19th century, the list of subject matter continued to include arithmetic; however, clarification indicated the list was prioritized, meaning arithmetic was the third most important subject to be taught (Marsh & Willis, 2007). In the early 1900s, Bobbitt espoused ideas of efficiency that replicated industries of the day. In other words, he suggested that mathematics instruction should include procedures most often used by bankers and merchants (Marsh & Willis, 2007). The ebb and flow of educational transformation continued virtually unchanged until the former Soviet Union launched Sputnik. This event caused an outcry for American schools to train better mathematicians and scientists (Marsh & Willis, 2007). Marsh and Willis (2007)

explained that Jerome Bruner provided packages of curricula. The element of "discovery education" was part of Bruner's packages. Students would not be taught the structure of subjects such as mathematics, but they would discover the principles for themselves. As the NCTM began to publish standards for mathematics curriculum, teachers chose to implement the new standards at a level based on their experiences with the subject (Marsh & Willis, 2007).

NCTM. NCTM has taken the position that mathematics instruction driven by problem-solving based tasks for students is the appropriate way to promote student learning and confidence in mathematics. When publishing the document outlining professional standards for teaching mathematics in 1991, NCTM asserted that students should be involved in making conjectures, proposing approaches as well as solutions to problems, and debating the validity of their ideas. In a more recent publication involving mathematics standards, NCTM (2000) further asserted that the major goal of the school mathematics program is to "create autonomous learners, and learning with understanding supports this goal" (p. 21). NCTM (2000) stated that students learn more and acquire a greater understanding when they are allowed to take control of their learning and are instructed using practices which support conceptual understanding.

The student-centered, standards-based approach aligns with standards developed by NCTM. In 1989, NCTM produced a document outlining their standards for curriculum and evaluation. In these standards, NCTM (1989) called for the following goals for all students:

> 1) that they learn to value mathematics, 2) that they become confident in their ability to do mathematics, 3) that they become mathematical problem solvers, 4) that they learn to communicate mathematically, and 5) that they learn to reason

mathematically. (p. 5)

In addition, a decreased emphasis on memorization of facts with an increased emphasis on active engagement and realistic problem-solving was outlined.

NCTM (1991) explained that mathematics teachers should pose tasks that build student understandings and skills in mathematics while stimulating them to make connections and create meaningful frameworks for mathematical ideas. In standard two, NCTM (1991) indicated that the teacher should coordinate discussions that pose questions and tasks that require student engagement and challenge their thinking. The teacher should listen carefully to the ideas of the students but also ask questions requiring students to clarify or justify their ideas either orally or in writing. Based on the observations and informal assessment of the students, the teacher determines into which areas to dig more deeply from the student generalizations in their discussions (NCTM, 1991). The teacher must also determine when or if to bring in mathematical notation as well as when to provide information, clarify, model, lead, or allow students struggle. In this standard, teachers must monitor the participation of all students in the discussion and how to encourage involvement (NCTM, 1991).

Common core movement. In 1989, President George W. Bush and the governors of all 50 states called for a set of national standards that would level the playing field of learning for the nation's school children (Tyack & Cuban, 1995). This initiative called for fewer topics to be taught in math with a focus on increased rigor by building strong foundations in concepts along with strong procedural skills and fluency and an ability to apply math knowledge to problems in and out of the classroom (Common Core State Standards Initiative, 2016). This movement arose, as Green (2014) wrote, because "the new math of the 1960's, the new math of the '80s and today's

Common Core math all stem from the idea that the traditional way of teaching math simply does not work" (par. 15).

Reasons for initiating role. While considering the impact of the role of a mathematics curriculum coach, time must be taken to examine why this role was implemented. Although mathematics has been part of the academic landscape throughout much of history, instructional approaches have changed over time. During the late 1990s and early 2000s, the movement towards conceptual understanding, the ability to understand math concepts deeply and have images in one's mind, began to re-emerge (Van de Walle & Lovin, 2006). With this push began a need to provide support for classroom teachers (Green, 2014). For most teachers, this new approach was contrary to the way they were taught as students and trained as prospective teachers. Gibson and Van Strat's (2001) research cited the idea that teachers teach the way they were taught. As a result, initiatives were begun to provide support for this paradigm shift.

As recently as 2008, the National Mathematics Advisory Panel indicated that the mathematics curriculum should include conceptual understanding. One of the benefits of effective instruction in this area would lead to student achievement (Nebesniak, 2013). Districts initially chose to add reading coaches based on three major reform factors: reform contexts, student performance data, and existing roles and programs (Mangin, 2009). Nebesniak (2013) asserted that conceptual understanding would benefit from the role of a mathematics curriculum coach with instruction focusing on the three key elements: conscious effort to develop conceptual understanding, making connections to other areas of the curriculum and the real world, and engaging students in learning while directing student attention. Obara and Sloan (2009) indicated that the role of a curriculum coach in mathematics is beneficial due to the challenges faced by teachers

when a new curriculum is implemented such as the Common Core State Standards. As districts sought to support teachers with the implementation of the new curriculum, as well as the shift to conceptual understanding, they moved to ways that would more actively support teacher learning (Mangin, 2009). Much like the account given by Obara and Sloan, many teachers share similar stories of the process of implementing a new curriculum that was required, and yet there was no support provided. Although teachers naturally want to do what is best for their students, factors such as lack of time, confirmation, or background knowledge often impede teachers from fully understanding and embracing the new methods or their understanding of them (Gwazdauskas, 2009).

Benefits of the position. Although the wealth of research on the impact of mathematics curriculum coaches is not as extensive as other academic areas, some research does exist that indicates that employing a position of this nature is beneficial. Some studies have shown that student achievement has improved over time, after the implementation of the curriculum coach (Nebesniak, 2013). Instructional practices by teachers have also shown some improvement as a result of providing ongoing professional development in the form of coaching (Ross, 1992).

When implementing the new Georgia Performance standards, a curriculum coach was utilized (Obara & Sloan, 2009). A study of this process shows the benefits of having such a position during the implementation phase (Obara & Sloan, 2009). In addition, the role of curriculum coach allows for ongoing, imbedded professional development which yields instructional change (Massey, 2009). In some cases, a curriculum coach is assigned to multiple school sites; however, McGatha (2009) found that one content-specific coach working in one school yielded more positive results than coaches who worked with multiple subjects in multiple sites. Valente (2013) agreed that the role of

math curriculum coach is beneficial through a study of schools in Tennessee which showed significant correlation between the use of the math curriculum coach and improved student achievement scores.

Valente (2013) went on to say that "Educators are under constant pressure from society at large and policy makers to adequately prepare our children to be productive citizens and compete in a global economy that demands mathematically literate members" (pp. 112-113). Data are released on an annual basis displaying how American students match up with students from other countries. Edmondson (2007) conducted a study that showed that students improved their achievement in specific areas of reading and math as indicated by teacher perceptions. Edmondson further reported that 90% of the teacher participants responded they had a definite effect on student learning and achievement. Two separate studies also indicated that teachers and students benefit from the role of a mathematics curriculum coach. Neufeld and Roper (2003) cited numerous benefits to using this role as it promotes improved learning communities among educators. Ingebrand's (2012) study corroborated the work of Neufeld and Roper. Ingebrand asserted that an improved implementation of research-based strategies occurred in the classrooms of teachers who were supported by a curriculum coach. Ingebrand also cited that the curriculum coaches have the opportunity to provide collaborative learning and support in such a way that principals are not afforded. This opportunity is a result of the position being that of coach, rather than of evaluator, as the principal is perceived.

Purpose

This mixed-methods study sought to understand how teacher instructional practices and sense of self-efficacy are impacted when a mathematics curriculum coach is

utilized in a school setting. This study also sought to compare these teachers to those at School B who do not have access to a math coach but a general curriculum coach.

Research Questions

1. What is the impact of the use of a math curriculum coach on teacher instructional practices in the area of math?
2. What is the impact of the use of a math curriculum coach on teacher perceptions of their instructional practice?
3. What is the impact of the use of a math curriculum coach on teacher sense of self-efficacy?

Variables

Because this research study is a mixed-methods study, the true variable that exists is the personal teacher self-efficacy which will be reported using the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI; Enochs, Smith, & Huinker, 2000); however, there are three main factors that influenced the outcome of this study. The first factor is the type of interaction the math coach has with teachers developing plans and reflecting upon their practice. The second factor is the implementation by teachers of research-based practice. In other words, do the teachers use examples of instructional research-based practice as shared by the math coach? In addition to these factors, teacher willingness to work with the math coach and provide honest responses to focus group interviews or individual interviews could have impacted the reliability of the findings of this study. Creswell (2014) and Yin (2014) agreed that interviewees respond through their lens of understanding of a situation and thus give answers they believe the researcher wants to hear.

Defining the Terms

Conceptual understanding of mathematics. Understanding a concept in such a way as to know and understand a concept and have constructed relationships in one's mind (Van de Walle & Lovin, 2006).

Constructivist theory. The theory that a person constructs meaning based on his experiences and understanding of their environment (Drago-Severson, 2009; Hall & Hord, 2011; Stake, 1995; Van de Walle & Lovin, 2006).

Focus groups. "A small group of people who possess certain characteristics, provide qualitative data in a focused discussion to help understand the topic" (Krueger & Casey, 2015, p. 6).

General teacher efficacy. The beliefs a teacher has regarding the influence of external factors over her influence within the classroom (Ross, 1992; Tschannen-Moran, Woolfold Hoy, & Hoy, 2008).

Interactions with the math coach. For the purpose of this study, these interactions will be defined as the interactions such as analysis of data, planning of lessons, reflection upon lessons, and discussion of instructional strategies of the math coach with the classroom teacher.

Journaling. A process of recording feelings and reflections regarding interactions with teachers in a journal or log (Ash, 2010).

Mathematics curriculum coach. A position intended to support the mathematical learning of all students by collaborating with teachers to improve their teaching of mathematics (Felux & Snowdy, 2006). This position is also referred to as a math coach, lead math teacher, or math specialist.

Mathematical proficiency. Five strands necessary for anyone to learn

mathematics successfully: understanding, computing, applying, reasoning, and engaging (Kilpatrick & Swafford, 2002).

NCTM. An international professional organization committed to excellence in mathematics teaching and learning for all students (NCTM, 2000).

One-on-one interviews. A form of open-ended interview used to obtain detailed information from participants to explain the problem being studied (Creswell, 2014).

Procedural knowledge. "Knowledge of the rules and the procedures that one uses in carrying out routine mathematical tasks and also of the symbolism that is used to represent mathematics" (Van de Walle & Lovin, 2006, p. 8).

Professional development. "A broad term that applies to teacher participation in programs designed to expand teachers' knowledge and promote higher levels of student learning in the school" (Danielson, 2006, p. 80).

Professional learning. A process in which an individual invests himself in such a way as to create professional knowledge by challenging previous assumptions and developing new meaning (Easton, 2008).

Research-based practice. The use of instructional practices that are based on research (Wright, 2007).

Teacher efficacy. The belief a teacher has of her ability to impact the motivation and achievement of her students (Balls, Eury, & King, 2011; Ross, 1992; Tschannen-Moran et al., 2008).

Teacher self-efficacy. The belief in one's ability to teach effectively (Enochs et al., 2000).

Willingness to work with math coach. For the purpose of this study, the term refers to a teacher's indication that benefits exist in working with the math coach as well

as agreement to work with the coach.

Conclusion

The goals of mathematics instruction and assessment have changed drastically over the years. Teachers are now expected to present material in such a way as to build student understanding of the concepts of math rather than being able to regurgitate a set of steps or some other form of procedural knowledge. This change first began with NCTM developing a set of standards outlining this instructional approach. In addition, many states participated in the development and implementation of the Common Core State Standards. This new curriculum, which was based on the standards set forth by NCTM, also brought changes to end-of-year assessments by which student learning was measured. Because student achievement dropped and teachers were unable to make or were uncomfortable with the shift to this approach, school districts far and wide began to examine ways to address this need (Green, 2014). Two school systems within a southeastern state experienced the implementation of a mathematics curriculum coach or general curriculum coach in two of their Title I schools. This case study examined the role of the math coach at one of these schools in comparison to a school that does not have a designated math curriculum coach as well as the impact the coaches have on the instructional practices and sense of self-efficacy of the teachers involved.

Chapter 2: Literature Review

This study sought to examine the impact a mathematics curriculum coach has on teacher instructional practice and teacher self-efficacy. Chapter 2 explores the literature available relating to the role of a curriculum coach, teacher efficacy as tied to mathematics, professional development, instruction, and assessment. This literature review links these topics to the role of a mathematics curriculum coach.

Background

As education dollars decrease, districts must carefully consider how they spend them (North Carolina Justice Center, 2013). In some systems, math curriculum coaches have been implemented to address the shift in instructional practice in mathematics as supported by NCTM and the Common Core (Ash, 2010; McGatha, 2009; Nebesniak, 2013; Nicometi, 2011; Obara & Sloan, 2009; Valente, 2013). Although a large pool of research on this particular role does not exist, much information is available about constructivist theory, teacher efficacy, professional development, use of manipulatives, and test scores and measurement. In this literature review, these topics are explored as they relate to the impact math coaches have on instructional practice and student achievement.

Theoretical Framework

The framework of this research is affected by four key areas: instructional approaches, teacher efficacy, continuing education, and assessment. Subfactors of these areas can be seen in Figure 1.

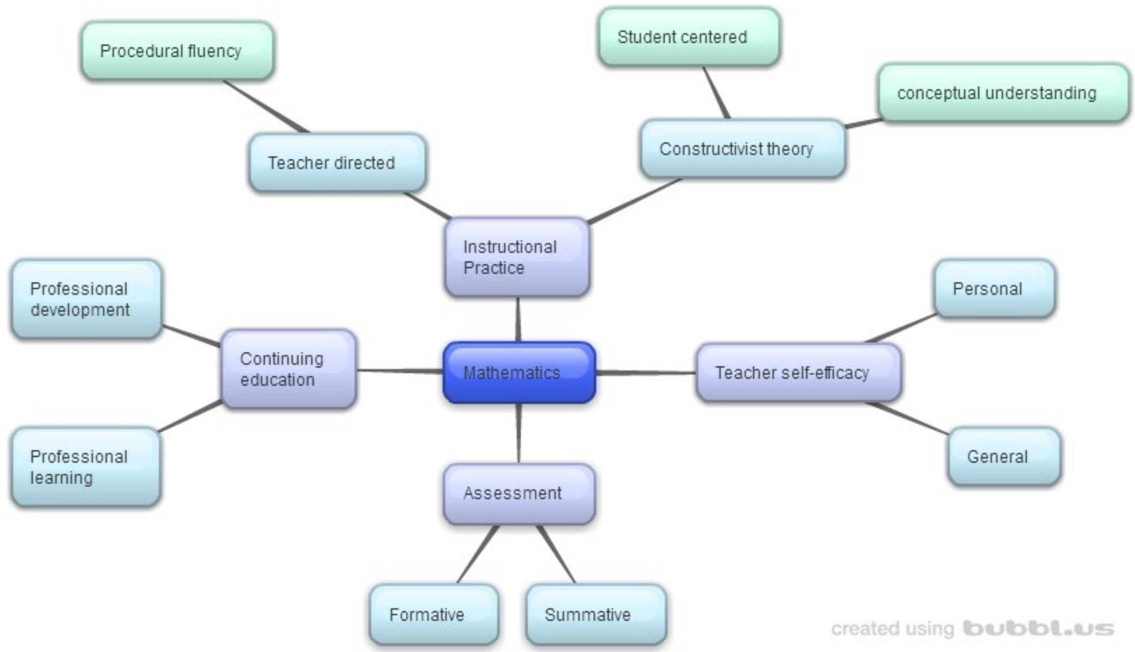

Figure 1. Theoretical Constructs in Mathematics.

Theory. The research in this mixed-methods study is based on the constructivist theory. This theory places emphasis on understanding a reality or the interactions between individuals (Creswell, 2014; Hall & Hord, 2011). With a goal of building a universal understanding of the role and impact of a mathematics curriculum coach, this research study constructed meaning from data collected using surveys, focus groups, and one-on-one interviews (Stake, 1995).

Methodology. As others have found, the body of research related to math coaches is minimal (McGatha, 2009, Nicometi, 2011). Many of the studies fall into either the case study or mixed-methods categories. Meaning in this study was created from the data collected using a survey, focus groups, and one-on-one interviews (Creswell, 2014; Plano Clark & Ivankova, 2016). Studies with similar design were reviewed to inform the researcher's methods.

In a previous study, Ash (2010) used qualitative methods to better understand the teacher perspectives about working with the math coach. This study took place in a small rural district in Ohio. Ash's study was bounded by three research questions:

1. To what extent do math mentee teachers use a math coach?
2. What influence does a math coach have on the instructional practices of math mentee teachers?
3. To what extent do the instructional practices of the math mentee teachers change when interacting with a math coach? (p. 3)

During this month-long study, 10 math mentee teachers and one math coach participated in open-ended interviews. Although a small number of participants were involved, the purpose of the interviews was to construct meaning from teacher perceptions (Ash, 2010). Similar to the current study, Ash (2010) reported that teachers who participated in the study had a positive attitude regarding working with the math coach, and they demonstrated changes in their instructional practices in response to their interactions. In his work, Ash recommended that future research utilize a mixed-methods approach to explore this subject.

In a similar study, Nicometi (2011) used mixed methods to understand the perception of teachers regarding the role of a math coach. This study included 45 teachers, or 29.8%, of 151 teachers from five elementary schools in a large county in southeastern United States. Within the five schools, there were four math coaches (Nicometi, 2011). The research questions for this study were

1. What is the perceived impact math content coaches have had on instructional practices of Grade 3, 4, and 5 teachers and what is the perceived impact on student learning?

2. What is the validity and reliability of the ALSDE survey and its underlying factor structure? (Nicometi, 2011, p. 1)

In this study the survey results were analyzed and used to develop the questions asked during the follow-up interviews (Nicometi, 2011). The follow-up interviews included 15 teachers, or 33.3% of respondents. Although the response rate was low, Nicometi found responses to be consistent. Similar to Ash (2010), Nicometi recommended that future research include quantitative data.

In a mixed-methods study, Massey (2009) used both quantitative and qualitative methods to study the influence an instructional coach had on teacher knowledge and instructional practice over a 2-year period. The research questions explored the extent the coaches felt prepared and felt that teachers used the instructional practices shared with them as well as the roles and responsibilities of these reading coaches (Massey, 2009). A survey was used to obtain information from a representative group and to explain findings that might influence policy. The interviews were used to gain in-depth information not provided by the survey (Massey, 2009).

In the fall of the study, 78 of the 96 coaches responded to the survey. In the spring, 75 coaches responded. As part of the follow-up interview, 10 coaches were asked to participate, but only four responded (Massey, 2009). The interviews provided an in-depth view of coaches' perceptions regarding their roles and their interactions with the teachers as well as their perceptions of changes to teacher instructional practices. Additional artifacts, such as weekly coaching schedules and conferencing templates, were used in this study.

Two studies regarding instructional coaches were also reviewed. Edmondson (2007) used mixed methods to provide elaboration on the issue with surveys and

interviews that a single research method would not provide. The purpose of this study was to analyze the execution of the instructional coach's role and its impact on teacher efficacy as well as the relationship to student achievement (Edmondson, 2007). During this year-long study, Edmondson worked with 10 elementary schools in a suburban district west of Chicago. This study included survey data, quantitative coaching log data, and interview data that were used to elaborate upon the research questions.

Edmondson's (2007) study covered 16 research questions. The questions addressed time spent in coaching activities, and the extent to which factors such as teacher assignment, teacher experience, or teacher educational degrees might influence teacher perceptions of the coaches' impact on student learning. Also addressed by the questions were possible differences in the coaches' impact on various content subjects or teacher efficacy. Finally, the questions looked for possible links between coaching and student achievement or teacher efficacy (Edmondson, 2007).

Because the researcher was a coach in two of the 12 schools in this district, the two related schools did not participate in the study. From the schools of focus, 242 classroom teachers were invited to participate in the survey along with eight instructional coaches. A pool of 48 teachers were interested in participating in the interview phase of the research. Seven of the interested teachers were randomly selected to be interviewed (Edmondson, 2007).

Although Kubek (2011) used a case study method, quantitative methods were also incorporated in the study. The study included interviews of participants as well as surveys to gain a depth understanding of the situation and the influence of the coach. Over a period of 2 years, Kubek studied a subset of schools within a Mid-Atlantic school district. This study sought to examine the attitudes of participants in professional

development activities as a previous district position transitioned to become an instructional coach. Kubek also reviewed the implementation process and its influence on teachers.

The three research questions were

1. What are teacher, administrator, and coaches' attitudes towards coaching as a means of improving instruction?
2. How has the coaching model affected teacher participation in professional development as indicated by teacher self-reports and administrator interviews?
3. How has the coaching model changed instructional practices as indicated by interviews of both teachers and coaches alike? (Kubek, 2011, p. 15)

A common term shared with this study is professional development. The three instruments used in this study were a survey, interviews, and observation data (Kubek, 2011). As is true in more than one study, triangulation and member checking were used to improve the validity of the results. Kubek recommended that future research include information regarding teacher tenure and whether this characteristic affects attitudes.

These research studies influenced the choice to used mixed methods to investigate the questions of this research study.

Role of the Math Curriculum Coach

Job description. The literature indicates that many descriptions and many names exist for the role of math curriculum coach, which is an example of a content specific curriculum coach (Ash, 2010; Confer, 2006; Felux & Snowdy, 2006). In some instances, the job of math curriculum coach is held at the district level, resulting in the coach serving multiple schools. On the other hand, there are many situations where the coach is assigned to a single school allowing for continuous support of the staff (Flammang, 2009;

Michelson, 2013; Poglinco et al., 2003; Trombly, 2012). In addition to the assignment scenarios, a wide variety of job descriptions exist, and the role is sometimes not clearly defined. Suggestions for job descriptions can be located in many of the articles currently available (Bean & DeFord, 2012; Confer, 2006; Valente, 2013).

Dewey (1916) indicated that coaching refers to the professional growth of an individual by being actively involved in learning. The U.S. Department of Education (2002) outlined a description for a literacy coach which can be used as a guide for developing the description for a math curriculum coach. Based on recommendations from the International Reading Association, the U.S. Department of Education defined the minimum qualifications of a literacy coach as a teacher who demonstrates excellence in reading instruction, preferably at the level at which assigned as coach; possesses expert knowledge of reading processes, acquisition, assessment, and instruction; demonstrates expertise in coaching teachers to improve their practice; has demonstrated an ability to present and facilitate group interactions; and has the credentials that enable the coach to model, observe, and provide feedback to classroom teachers regarding instruction (National Reading Technical Assistance Center [NRTAC], 2010). In addition to the qualifications outlined in their study, NRTAC (2010) recommended that coaches have the skills necessary to identify the positive in every interactive opportunity; demonstrate acute listening skills, constructive questioning abilities, and trustworthiness; possess a sincere belief that the teacher/coach model is a means to address professional development; actively support individual teacher learning needs; facilitate individuals and groups in the identification of their strengths, areas of growth opportunities, and steps needed for improving instruction; model instruction and coaching that recognize the diversity of students and teachers; and demonstrate appropriate communication with all

involved for the success of the reading program.

Recommendations for effective coaching. Many suggestions for ways to coach effectively could be found while reviewing the literature. Some of the literature provided the information as a top 10 list, while others provided bulleted lists with explanations provided. Many of the documents included some of the same suggestions. Confer's (2006) 10 guiding principles for a mathematics curriculum coach address the repeated suggestions.

1. Good relationships with teachers should be a priority.
2. The coach should portray himself/herself as a co-teacher, not an evaluator.
3. In the beginning, the coach should work with teachers who are interested, curious, or open to change about a different way to teach math.
4. The coach should acknowledge that change in instruction happens when support relates to teachers' specific classroom needs.
5. The coach should provide teachers with ongoing changes to meet with other teachers to be learners of mathematics and to reflect on their learning.
6. The coach should encourage teachers to share what they are learning about teaching mathematics.
7. The coach should communicate with his/her administrators.
8. The coach should create a mathematically rich school environment.
9. The coach should acknowledge that parents/guardians are an untapped resource.
10. The coach should surround himself/herself with a support system.

In a study in Tennessee, Valente (2013) made the following recommendations for math curriculum coaches: respond to a teacher's or principal's request for assistance;

discuss with teachers content to be addressed or improved; observe a teacher and discuss what was noted; design or help with lesson design; co-teach with teacher upon request; design and present workshops for teachers; assist with design and administration of assessment; search for resources based on teacher needs; provide technology and ongoing support; use teacher feedback as a self-evaluation tool; and provide support for increased content-knowledge.

Based on the experiences of literacy coaches, Bean and DeFord (2012) had the following suggestions based on the literacy coach position: A coach should introduce herself and her role, work with all teachers, work first to develop a relationship of trust, work with her administrator, recognize and appreciate differences in teachers and how they work, recognize her own attitudes and beliefs about teaching and learning, establish priorities, let the data lead, be a learner, and document her work. These recommendations mirror those of Confer (2006) for math coaches. NRTAC (2010) described the role of a literacy coach in much the same way as Confer and others defined math coaches.

Other studies and articles outline practices that should be considered as part of the role of the curriculum coach. For example, Gwazdauskas (2009) suggested that evaluative conversations be included as best practice for the role of curriculum coach; however, most other scholarly articles indicate that evaluative duties tend to harm the benefits of the coach, as teachers see them as more of an evaluator or administrator rather than a coach (Ash 2010; Barry, 2012; Bennett, 2013; Confer 2006; Debacker, 2013; McCrary, 2011). Gwazdauskas himself seemed to contradict his statement as he suggested that the coach and the teacher need to work together as a team to plan, gather resources together, co-teach as part of the experience of implementation, spend time

reflecting on what worked and what did not work, and follow up in the future with additional attempts. Goal setting can be a useful tool when used in relation to benchmarks. In so doing, the role of coach can be kept in perspective (Neufeld & Roper, 2003). Drago-Severson (2009) described Keagan's Ways of Knowing and the concepts of teaming while outlining procedures for working with adult learners. Drago-Severson indicated that coaches should be knowledgeable of this information to be successful. Although most of the research referenced here outlines steps for coaches, Neufeld and Roper (2003) outlined steps districts should take to make the most of the role of a mathematics curriculum coach. Neufeld and Roper indicated that districts should develop a means to evaluate the coach's quality and impact. In so doing, there should be clear criteria for evaluating the coach's work and developing an evaluation instrument that can be used in a formative or summative manner.

Obstacles to Successful Coaching

In reviewing the material regarding curriculum coaches, several themes stood out as to the obstacles that curriculum coaches face and the success of their roles. One obstacle is poorly defined job descriptions (Obara & Sloan, 2009). Rapcki and Cross-Francis (2014), Debacker (2013), Obara and Sloan (2009) and Edmondson (2007) indicated that the role of a curriculum coach is often undefined. Failure to clearly define the expectations of the role leads to resistance from teachers, lack of support by administrators, and stress for the coach while being unable to keep up with the demands placed upon him/her (Debacker, 2013). As a result, establishing a clearly defined job description and communicating the expectations of the role seem to be very important to removing this obstacle (Debacker, 2013). The Obara and Sloan study in Georgia found the lack of a clearly defined role to be an obstacle to successful coaching. Rapcki and

Cross-Francis also found that teachers were resistant when the description for the job of curriculum coach was ill-defined. Debacker's study also supported the idea that curriculum coaches with poorly defined job descriptions face difficulties working with teachers.

Communication. Depending on the base assignment of the curriculum coach, communication may be an obstacle for effective coaching. Rapcki and Cross-Francis (2014) found that coaches who serve multiple schools may have to be creative in their means of communication by using tools such as email for communication. Being able to maintain confidentiality through communication is important as well (Rapcki & Cross-Francis, 2014). If a curriculum coach is going to build relationships with teachers, regular communication must take place (Rapcki & Cross-Francis, 2014).

When curriculum coaches serve multiple sites or the faculty of one site is large, strained communication can result due to the number of teachers to be served (Debacker, 2013). In addition, serving multiple sites makes face-to-face communication difficult for coaches (Rapcki & Cross-Francis, 2014). Although curriculum coaches should be experts in their field, administrators sometimes make decisions without the coach's input which can be an indicator of poor communication or lack of communication between the two. Such dynamics are indicative of obstacles to communication (Debacker, 2013).

Content knowledge. In this role, content knowledge is very important. Rapcki and Cross-Francis (2014) and Kubek (2011) found that those who hold the coach position must be experts in the content area. Despite such knowledge, obstacles still may arise as teachers distrust the provided resources or information due to the coach's lack of experience with the age or grade (Rapcki & Cross-Francis, 2014). Often, teachers assume that a coach does not know students if he/she has not had experience with that

grade or age (Rapcki & Cross-Francis, 2014). When math curriculum coaches have such differences in age or experience, teachers often feel that coaches have nothing to offer them (Kubek, 2011).

Other obstacles. Other obstacles may appear as the curriculum coach endeavors to assist the classroom teacher. In the case where the coach is younger or less experienced than the classroom teacher, the classroom teacher may not be responsive to the support offered (Rapcki & Cross-Francis, 2014). In addition, teachers often see coaches as a type of administrative role in which observations are meant to be evaluative. Such a perspective results in the coach not being invited into the classroom to observe (Rapcki & Cross-Francis, 2014). In addition, teachers sometimes lack self-confidence in the area of mathematics and feel intimidated by the possibility of being observed even in a supporting role (Rapcki & Cross-Francis, 2014). As a result, the coach again may not be invited to observe in the classroom and must then go into classrooms unwelcomed based on administrative expectations. Another obstacle that coaches sometimes face is a difference in principal expectations or instructional philosophy and that of the coach's perspective. As a result, the coach serves as a middleman or mediator while trying to find common ground in order to bring about improvement in instructional practice and student achievement (Debacker, 2013). When an administrator requests a meeting with the coach during a time that the coach is to meet with or observe a classroom teacher, the coach may experience an obstacle to effective coaching as well. In such instances, the teacher perceives that his/her needs are unimportant to the coach (Debacker, 2013). This same study also indicates that curriculum coaches have difficulty fulfilling their roles of assisting with instruction when assigned too many tasks that are not directly related to instructional coaching (Debacker, 2013).

Gwazdauskas's (2009) research found several obstacles to the curriculum coach effectiveness. Problems with insecurity, resistance to change, time constraints, teacher attitude, tenure on staff, and resentment of the role were seen as barriers to a curriculum coach's effectiveness. Gwazdauskas (2009) also found that teachers perceive the curriculum coach to have a position of great flexibility and ease which feeds the resentment to the position. As with change of any type, buy-in by classroom teachers, as far as their use of the coach, takes time. Two other obstacles that impact the effectiveness of the math curriculum coach are the issue of schedule time and the fixed mindset of some teachers. Schedule time often creates hindrances to effective coaching due to the inability of the coach to follow up with teachers after observations. Some teachers have the perception that new strategies do not work or they are just another fad that will soon pass (Neufeld & Roper, 2003). One final obstacle to be cited is the lack of teacher involvement in the decision-making process to implement a curriculum coach. Often, this obstacle affects teacher attitude (Kubek, 2012). Many factors exist that can be obstacles to the positive impact of a curriculum coach.

Teacher Efficacy

Teacher efficacy is the belief a teacher has in one's ability to impact the motivation and achievement of one's students (Balls et al., 2011; Ross, 1992; Tschannen-Moran et al., 2008). Similarly, Bandura (2006) defined self-efficacy as a person's ability to take actions necessary to achieve a desired outcome. General teacher efficacy is the belief a teacher has regarding the influence of external factors over her influence within the classroom (Ross, 1992; Tschannen-Moran et al., 2008). The sense of self-efficacy is more specific to one teacher than the belief of what teachers as a collective body can accomplish (Tschannen-Moran et al., 2008). Rotter (1966) indicated that teacher efficacy

is powered by the belief that factors under the teacher's control have a greater impact on student achievement than external factors. Bandura's theory indicates that self-efficacy influences a person's pursuit of goals and her response to adversity and setbacks. Self-efficacy is not the same as self-esteem. Self-esteem is an evaluation of one's self characteristics such as belief in one's self-worth (Tschannen-Moran et al., 2008). Teachers with a strong sense of self-efficacy tend to set higher goals, are more organized and better planners, tend to be more persistent with students who struggle, are more open to try new ideas for the benefit of their students, and are less likely to be critical of students who make mistakes (Ross, 1992; Tschannen-Moran et al., 2008).

A teacher's self-efficacy has been found to have an influence on student learning. For example, Ross (1992) indicated that personal teacher efficacy predicted student achievement of third-grade students in the subjects of reading, math, and language. This self-efficacy is based on what a teacher knows, does, and cares about, according to Hattie (2003). In addition to student achievement, teacher efficacy has been found to influence student feelings toward school and their evaluations of their teachers (Tschannen-Moran et al., 2008). This information is important to consider as Riggs and Enoch (1990) indicated that teachers tend to avoid subjects where they lack confidence. This low self-efficacy typically affects the time scheduled for or emphasis placed on subjects connected to poor self-concept (Rogers, 2014).

In terms of mathematics instruction, NCTM and the Common Core State Standards promote instructional practice that is different from the math instruction of the past (Green, 2014). In response, teachers must examine the teaching task in order to determine their self-efficacy. What does the task require to be successful and to produce appropriate student achievement? Student motivation, the needed instructional strategies,

and available instructional resources and technology as well as teacher preparation all influence teacher efficacy in this area (Tschannen-Moran et al., 2008). Tschannen-Moran et al. (2008) indicated that a teacher's level of confidence to address the demands in a particular area will influence how he/she functions within that context. Student success is impacted by teacher preparation in the subject matter he/she teaches as well as his/her knowledge of that subject matter according to Darling-Hammond and Bransford (2005). Darling-Hammond and Bransford also explained that a teacher's subject matter knowledge impacts student success on standardized tests as well. With the implementation of the Common Core State Standards for Mathematics (CCSSM), one group of researchers noted a substantial body of research indicating teachers are the most influential factor in promoting student mathematics learning, and the education of the teachers is an essential component for improving education (Sztajn, Marrongell, & Smith, 2011).

Ross (1992) connected this information to coaching by stating that teachers who possess a belief that they will make a difference in their students are more likely to view coaching as an opportunity to improve their practice. In addition, teachers who risk receiving negative feedback from a coach tend to be those who have a strong personal teaching efficacy. Ross further stated that teachers who view student learning as overshadowed by forces beyond their control tend to also view coaching as more work. Ross cited previous work that shows more student growth occurred in classes of teachers who reported greater use of a coach and in classes of teachers who expressed stronger beliefs in their personal teaching efficacy. Coaches have also demonstrated that they are more motivated by teachers with high efficacy because they tend to see the worthiness of instructional improvement as well as teachers who need the least help (Ross, 1992).

Continuing Education

Professional development. Professional development is meant to improve student learning through improving teacher knowledge and instruction (Doerr, Goldsmith, & Lewis, 2010). According to NCTM (2011), support of teacher learning should be the focus of any professional development that seeks to facilitate implementation of the CCSSM. When professional development is used for mathematics, there are typically four core areas: build teacher mathematical knowledge and capacity to use it; build teacher capacity to analyze and respond to student thinking; build teacher productive habits of mind, which affect self-efficacy and dispositions for improving instructional practice; and build professional networks that support continued learning (Doerr et al., 2010). Professional development in and of itself does not automatically create these characteristics in teachers. As a result, those who create professional development modules should consider exactly how these characteristics are being developed in the participants (Doerr, et al., 2010). Doerr et al. (2010) suggested that professional development should include substantial time investment, systemic support, and opportunities for active learning in order to support their goals.

When teachers have an opportunity to connect their learning experiences to their understanding of teaching and build their skills for analyzing their instruction, the professional development is considered effective (Sweetland & Fogarty, 2008). Other factors to be considered for effective professional development are the professional development is intensive, ongoing, and connected to teacher practice; the focus is on student learning and addresses specific teaching content; the professional development aligns with the priorities and goals of the school improvement plan; and it works to build a strong working relationship among teachers (Sztajn et al., 2011). Sztajn et al. (2011)

indicated that implementation of the CCSSM requires mathematics instruction to be conducted in very different ways than was done prior to the new standards. In addition, Sztajn et al. indicated that these changes will most likely be accomplished in a sustainable manner through effective professional development. Professional development can be provided through a variety of avenues; but it needs to be compatible with teacher time and availability, such as face-to-face and job-embedded opportunities (Sztajn et al., 2011). Some of the disadvantages to traditional professional development include the fragmented and episodic format along with wide ranges of quality and strength of learning activities. When professional development is offered in isolated segments not connected to a coherent program, the professional development ignores the needs of teachers for content that builds on itself allowing the teacher to accumulate her knowledge over time (Sztajn et al., 2011).

Professional learning. Professional learning can be defined as an ongoing, in-depth, systematic process in which an individual invests him/herself in such a way as to create professional knowledge by challenging previous assumptions and developing new meaning (Easton, 2008; Timperley, 2011). This element is in direct contrast to professional development which views teachers as participants (Timperley, 2011). Another core element of professional learning is that the question "What is best for students?" is the center of the process. The focus of learning seeks to assure that the knowledge and skills constructed during the professional learning meet immediate and future challenges of teaching and learning (Timperley, 2011). When a mathematics curriculum coach model is used, professional learning is supported in such a way as to build teacher knowledge of the subject, so student learning and understanding are supported as well (Costa & Garmston, 1994; Darling-Hammond & McLauglin, 1995;

Garmston & Wellman, 1999). As a result, improvement in student learning is not an outcome of the learning but rather the main focus and purpose of the learning (Timperley, 2011). Timperley (2011) called for professional learning designed under the premise that teachers are actively engaged and professionalism is demanded of participants. Timperley indicated that professional learning has demonstrated improvement in student outcomes in ways that are valued by the communities in which the students live. The superficial engagement of teachers (the norm of professional development) will not yield the transformational change required to change instructional practice (Timperley, 2011). Professional learning is often the result of teachers grappling with ideas and is typically personal and powerful. A body of research exists that indicates that professional learning is most effective when it occurs through collaboration (Ciampa & Gallagher, 2015). Professional learning of this nature cannot be achieved via shortcuts (Sweetland & Fogarty, 2008). Consideration of professional learning is important because studies have shown that professional development has failed to achieve goals of improving student learning and engagement. Timperley indicated that research has shown the success of professional development to be disappointing. Curriculum coaches have the opportunity to provide imbedded professional development that yields instructional change (Massey, 2009) as well as to learn collaboratively with the teachers in ways that professional development presenters and administrators do not (Ingebrand, 2012).

Some of the vehicles for professional learning are professional learning communities, lesson study, co-planning, and peer observations (Ciampa & Gallagher, 2015). Coaching is another form of support for professional learning; research indicates that coaching in combination with additional training methods produced more positive outcomes (Ross, 1992). One component of effective professional learning is

collaborative inquiry which provides opportunities for participants to improve their pedagogical and content knowledge as well as collaborative construction and implementation of new goals of instructional practice (Ciampa & Gallagher, 2015). Ciampa and Gallagher (2015) indicated that teacher inquiry and teacher engagement are necessary components of professional learning. They also recommended technological support be in place for any professional learning that includes technology (Ciampa & Gallagher, 2015).

Finally, support from educational leadership is vital for professional learning. Often, those who provide professional development only supply information or strategies, while those involved in professional learning work in partnership with leaders and teachers to build teacher capabilities enabling them to take control of their own future learning (Timperley, 2011). Curriculum coaches are in a position to fulfill the role of support needed in this model (Ingebrand, 2012).

No matter what type of continuing education is utilized, the improvement of instructional approaches used by teachers is a factor in student achievement. Direct instruction or constructivist theory are the vehicles often used to deliver the math content.

Instructional Approaches

For mathematics, there are numerous research-based instructional practices. Two of these practices are explored in more depth in this section.

Direct instruction. Direct instruction is the process by which children's implicit understanding becomes explicit and ready for use (Lazonder & Wiskerke-Drost, 2014). This method of teaching includes explanations, demonstrations, and instruction followed by guided practice and informal assessment of student understanding (Schmoker, 2011). This method is sometimes referred to as "sit and get" (Balls et al., 2011). Although

Benjamin Franklin suggested a transition to active inquiry during the 1700s, mathematics continued to follow the direct instruction model into the decades following the former Soviet Union's launching of Sputnik (Marsh & Willis, 2007). One of the most well-known models for direct instruction was constructed by Madeline Hunter (Steward, Martin, Burns, & Bush, 2010). Hunter's lesson model was designed to involve an introduction of clear objectives and goals for the lesson, an "anticipatory set" to hook student interest, and direct teaching which included modeling in brief, manageable chunks. The statement of objectives or standards portion of the lesson was designed to assist students in connecting the relevance of the material to them while providing a structure to the learning (Steward et al., 2010). The modeling phase of the lesson would be followed by guided practice and checks for understanding (Schmoker 2011; Steward et al., 2010). The phases of modeling and practice were to be repeated numerous times throughout the lesson (Schmoker, 2011). These phases share an emphasis on direct instruction (Steward et al., 2010). Independent practice and a closing phase are also part of this 7-step approach to instruction (Steward et al., 2010). Based on the work of Steward et al. (2010), the goal of this direct instruction is student mastery of information. According to Steward et al., studies have shown that direct instruction produces stronger skill development and that feedback and reinforcement are key to this development. Often, direct instruction is linked to a specific textbook or program (Kanfush, 2014).

Respected math educator Burns (2007) designed math lessons mimicking Hunter's model where students are taught in planned increments and the teacher models the learning while thinking aloud. Then the teacher provides students with opportunities to practice while she checks for understanding (Burns, 2007). Some studies have shown that explicit instruction can be as powerful as scaffolding difficult parts of a process

(Lazonder & Wiskerke-Drost, 2014).

According to Van de Walle and Lovin (2006) a negative of direct instruction is its disregard for student diversity. Although manipulatives are often used in mathematics instruction for exploration, when the teacher directs every step for students to complete, the instruction falls in the direct category (Van de Walle & Lovin, 2006). Another characteristic of direct instruction is students receive instruction that is fast paced with teachers asking questions that can be responded to using short answers. Typically, students also complete a large number of practice problems using a prescribed method (Hiebert & Grouws, 2007). Despite these aspects, students with disabilities have long shown success in classrooms that utilize direct instruction (Kanfush, 2014).

Constructivist theory. Piaget devoted his life's work to the understanding of a child's cognitive development (Drago-Severson, 2009). Much of his theory formed the groundwork for the constructive-development theory (Drago-Severson, 2009). The basic tenet of the constructivist theory is that children, yet all people, "construct their own knowledge" (Van de Walle & Lovin, 2006). In the decades following the launch of Sputnik, Bruner developed curricula packages that promoted discovery learning where students would not be directly taught the principles of mathematics but would discover the principals for themselves (Marsh & Willis, 2007). Work in mathematics since the 1960s, 1980s, and including the CCSSM, stem from the belief that the direct instruction of previous decades does not work (Green, 2014).

As part of the constructivist-development theory, Kegan worked on meaning-making systems (Drago-Severson, 2009). Two of his three primary ideas connect to constructivist theory. Kegan described constructivism as the way people actively construct and make meaning of their experiences with respect to development along

cognitive, emotional, intrapersonal, and interpersonal pathways (Drago-Severson, 2009). Kegan also defined developmentalism as the ways in which a person makes meaning and constructs her reality over time with developmentally appropriate supports (Drago-Severson, 2009). Brooks and Brooks (1993) indicated that constructivist pedagogy is a self-regulated process by which teachers and students resolve inner cognitive struggles through concrete experience, collaborative discussion, and reflection. Vygotsky added much to the understanding of learning by defining learning as a social process in which one's capacity to learn from others is crucial to a person's intelligence (Earl, 2013). Vygotsky explained that each person has a zone of proximal development (ZPD). The ZPD is the range of experiences in which a person with support and reasonable effort can successfully negotiate to a point of understanding (Earl, 2013).

Constructing ideas is much like building a physical object which requires tools and materials. As an individual constructs understanding, he/she uses prior knowledge to make connections to the new understanding. The more previous ideas are used, the more the person is able to make connections to the new idea and thus understands more deeply (Van de Walle & Lovin, 2006). Students who are instructed with more challenging problems are more likely to develop deep conceptual understanding of the mathematics (Hiebert & Grouws, 2007). Simply put, teachers who use the constructivist theory in their instruction assist their students in resolving cognitive struggles and exploring new ideas and concepts as a means to create new knowledge and understanding (Marsh & Willis, 2007).

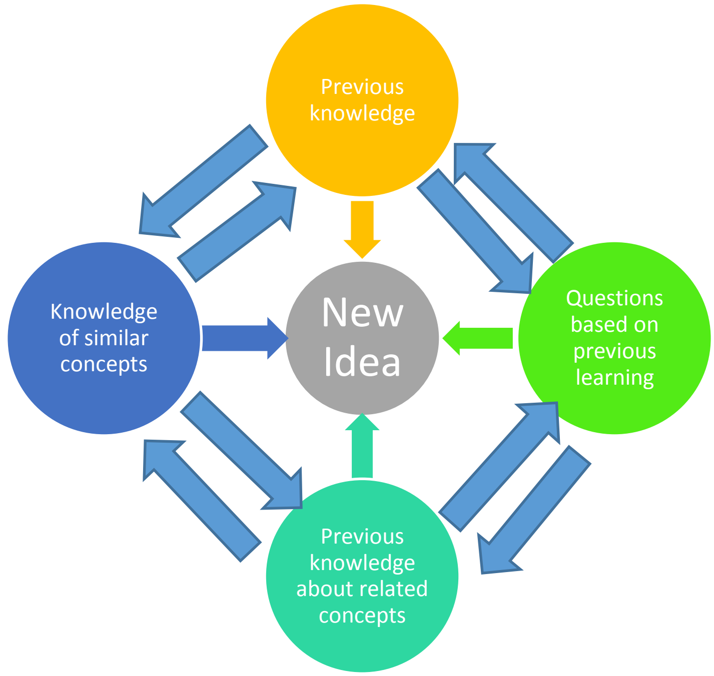

Figure 2. Connecting Ideas to Construct New Knowledge.

Figure 2, based on information from Van de Walle and Lovin (2006), shows how new ideas can be connected to other knowledge. Ideas learned through rote procedures are easily forgotten because of the lack of connections to previous learning (Van de Walle & Lovin, 2006). Earl (2013) explained that students grow in their understanding along a continuum. Previous knowledge connects not only to knowledge of similar concepts but also to new ideas and questions based on previous learning. No aspect of student knowledge is disconnected to the other components. At the emergent stage, a person has no practical experience and is dependent upon rules to help him progress. Proficient stage learners understand the context of their learning, integrate ideas into efficient solutions, and solve problems by making alterations as needed (Earl, 2013).

No practical experience. Dependent on rules.	Expects definitive answers. Some recognition of patterns. Limited experience. Still relies on rules.	Analytical. Locates and considers possible patterns. Has internalized the key dimensions so that they are automatic.	Uses analysis and synthesis. Sees the whole rather than aspects. Looks for links and patterns. Adjusts to adapt to the context.	Understands the context. Has a holistic grasp of relationships. Considers alternative in an iterative way and integrates ideas into efficient solutions. Solves problems and makes ongoing adaptations automatically.

Figure 3. Stages in Growth from Emergent to Proficient. Source: Earl (2013).

Constructivism theory asserts that teachers cannot teach students by telling (direct instruction), but rather that knowledge is built through social settings and conversations (Earl, 2013). To the contrary, teachers must help their students construct their ideas using their prior knowledge (Van de Walle & Lovin, 2006). Figures 2 and 3 show how new ideas are connected to knowledge the learner possesses, while this knowledge is utilized in different ways as the learner progresses along the growth continuum. In an address to AERA, Darling-Hammond (1992) stated learning is maximized when people make connections between the current knowledge base and the information to be learned; when they draw from their experiences to make greater meaning of the new material; and when they apply what they are learning in meaningful ways.

Three key factors influence math learning: student reflective thinking; social interaction with classmates; and use of models, manipulatives, or other tools for learning

(Van de Walle & Lovin, 2006). Constructivism utilizes models to help students learn important mathematical ideas (Van de Walle & Lovin, 2006). Van de Walle and Lovin (2006) further asserted constructivism theory in mathematics uses problem-based learning which allows students to apply their understandings to a problem situation. In other words, the constructivist approach has teachers presenting students with problems to which they develop an approach to solving and then must explain their thinking and strategy (Hall & Hord, 2011). This approach is student centered rather than teacher centered (Van de Walle & Lovin, 2006). Seeley (2009), former president of NCTM, views constructive struggle as part of the constructivist approach to mathematics. Students struggle with problems, while the teacher provides guiding questions without telling the students how or what to think and without giving them the answer. These questions are open-ended to facilitate the constructivist learning (Marsh & Willis, 2007).

Zambo and Zambo (2008) asserted that the constructivist theory embraced by NCTM is an appropriate developmental approach to mathematics because it begins and builds upon what children know, leading them to create relational understanding, problem-solving abilities, and logical reasoning abilities. Zambo and Zambo asked teachers to consider mathematical learning from a constructivist's perspective, because students do not merely absorb knowledge like a sponge but construct the knowledge from their experiences (Zambo & Zambo, 2008). Zambo and Zambo's study was based on the work of Zull, a biology professor, and examined some of the basic structures and cycle of learning the brain uses as it learns mathematics. Specifically, Zambo and Zambo addressed the following areas: the four regions of the brain, the learning cycle, and specific strategies teachers can use to begin the cycle and build their students' mathematical frameworks and connections. Constructivist, student-centered instruction

includes the development of representational models in order to interpret the mathematics of a task. NCTM's process standard of representation is based on the idea that sense-making begins in the sensory cortex of the brain. Zambo and Zambo indicated that the sensory cortex needs the experiences related to student-centered instruction in order for students to begin to construct mathematical concepts. One of the roles of the teacher is to engage in observing her students and to talk with them as they participate in these experiences. In so doing, teachers help the students make connections between the experiences students are given and the concepts which are the focus of the learning (Zambo & Zambo, 2008). When teachers provide rich sensory experiences, they are leading their students to the next step of processing: making connections to what is known (Zambo & Zambo, 2008).

These standards are also supported by the National Research Council's Mathematics Learning Study Committee (2002). In their publication, the committee mirrors NCTM's positions. Mathematical proficiency is seen to have five strands: understanding, computing, applying, reasoning, and engaging. These strands come from the council's mathematics committee who researched mathematics and developed the strands. The terms "constructivist" or "student-centered instruction" are not used in the book; however, the explanations and examples given throughout mirror the tenets of student-centered instruction (National Research Council's Mathematics Learning Study Committee, 2002). Nebesniak (2013) stated that the National Mathematics Advisory Panel believes that curriculum should include conceptual understanding, which means the instruction of mathematics focuses on the "why." This approach requires deeper investigation than simple procedures and processes. Nebesniak further stated that effective instruction focused on conceptual understanding, making curricular

connections, and efficiently directing student attention during instruction are the key elements that lead to student achievement. In addition, Sztajn et al. (2011) indicated that the implementation of CCSSM require mathematics instruction to be conducted in very different ways than was done prior to the new standards. This approach to instruction varies from the direct instruction most teachers experienced as students (Gibson & Van Strat, 2001; Green, 2014); however, education in this way was supported by Dewey (1916) who stated that the world of education would see a major revolution if teachers would realize that the evolution of the thinking process of their students rather than the ability to generate correct answers is the true evidence of educational growth.

Types of Assessment

Assessment of learning has been in existence for centuries, dating back to early Chinese civilization and Aristotle (Earl, 2013). The Industrial Revolution and universal schooling brought about changes to assessment as evaluation of student achievement (Earl, 2013). Although schools were mimicking the industrial society the United States had become, experts such as Dewey sought to create an educational system that served all students as a means for democratic, social, and moral growth. As the middle class began to push for greater access and equity to education, assessment of achievement became the foundation for awarding privileges. These assessments were used to sort students (Earl, 2013). Earl (2013) described that as World War I drew to a close, many sought to include evaluative measures in the educational setting that excluded teacher subjectivity and bias.

Over time, assessments such as the SAT were developed. Because the SAT was considered an objective measure of student ability, other external examinations were developed (Earl, 2013). Classroom assessment continued during this process but took

more of a summative role. Not until the 1980s did another dramatic shift take place in which assessment data were used as a means to hold schools accountable for student achievement (Earl, 2013). During this time, Earl (2013) explained that others began praising the benefits of assessment on learning. Over the last decade, many studies have shed great light on the value of the assessments teachers use every day in the classroom. Shirley (2009) stated that assessment should be focused on learning; and if the assessment system is hindering the student learning process, it needs to be modified or discarded.

During this recent movement, NCTM (2001) has asserted that traditional tests with percent correct grades give "solid" data; however, they raise the question as to whether these tests provide teachers with accurate information regarding what students know and understand mathematically. NCTM (1995) described four intertwined phases of assessment: plan assessment, gather evidence, interpret evidence, and use the results. They also described four purposes of assessment: monitor student progress, make instructional decisions, evaluate student achievement, and evaluate programs. NCTM (1995) indicated the results of such use of assessment would be to promote growth, improve instruction, recognize student accomplishments, and modify the program as necessary. With their description of and purposes for assessment, NCTM (1995) endorsed a movement in assessment. Table 5 shows the traditional assessment practices in comparison to the movement NCTM suggested.

Table 5

NCTM's Major Shifts in Assessment Practice

Toward	Away From
• Assessing students' full mathematical power	• Assessing only students' knowledge of specific facts and isolated skills
• Comparing students' performance with established criteria	• Comparing students' performance with that of other students
• Giving support to teachers and credence to their informed judgment	• Designing "teacher-proof" assessment systems
• Making the assessment process public, participatory, and dynamic	• Making the assessment process secret, exclusive, and fixed
• Giving students multiple opportunities to demonstrate their full mathematical power	• Restricting students to a single way of demonstrating their mathematical knowledge
• Developing a shared vision of what to assess and how to do it	• Developing assessment by oneself
• Using assessment results to ensure that all students have the opportunity to achieve their potential	• Using assessment to filter and select students out of the opportunities to learn mathematics
• Aligning assessment with curriculum and instruction	• Treating assessment as independent of curriculum or instruction
• Basing inferences on multiple sources of evidence	• Basing inferences on restricted or single sources of evidence
• Regarding assessment as continual and recursive	• Regarding assessment as sporadic and conclusive
• Holding all concerned with mathematics learning accountable for assessment results	• Holding only a few accountable for assessment results

Source: NCTM (2001).

As part of their work regarding assessment, NCTM (2001) used the term "assessment" when trying to answer the following questions:

1. How can I communicate my expectations about my students' mathematical understanding and the quality of their work?
2. What do I think my students understand at this point in time? What do they think they understand?
3. Does the question, task, or activity that I chose raise the mathematical issues I hope it will raise for my students? Does it provide an opportunity for them to show me what they know?
4. What question, task, or activity should I pose next?
5. How can I communicate to my students and others what I think they understand? (p. 2)

These questions are connected to the five standards that NCTM (2001) endorsed for guiding classroom assessments:

- Assessment should enhance mathematics learning.
- Assessment should promote equity.
- Assessment should be an open process.
- Assessment should promote valid inferences about mathematics learning.
- Assessment should be a coherent process. (p. 2)

To determine if students have successfully met the requirements of a standard, teachers must rely on multiple sources of information rather than just one test or document (NCTM, 2001). When blending instruction and assessment, as NCTM (2001) suggested, the benefits can be clear expectations for learning, assured fair assessments, lessons and planned activities focused on learning results and outcomes, adjusted instruction, and assessment as part of the learning process rather than an interruption. With this

perspective at the forefront of instruction, "Our feedback to students from assessment can enhance their learning" (NCTM, 2001, p. 23).

There are two types of assessment: formative and summative. Drago-Severson (2009) indicated that most educators have not been an extensively trained in this area. Drago-Severson stated that assessment is a crucial part of teaching and learning. In light of this fact, teachers could benefit from a focus on formative and summative assessment techniques.

Formative assessment. Formative assessment can be defined as the "day-to-day monitoring of what students are learning" (Seeley, 2009, p. 189) or checking for understanding (Schmoker, 2011). DuFour (2010) described formative assessment as assessment used to advance student learning, not just to monitor learning, but additionally to evaluate the effectiveness of instruction. This definition matches the definition provided by the American Education Research Association (AERA, 2014). A few examples of formative assessment are observations, interviews of students, journals, quizzes, tests, projects, classwork, listening to student discussions, signals for understanding, and use of dry erase boards for student work or solutions (NCTM, 2001; Schmoker, 2011). Earl (2013) recognized this form of assessment as fairly new on the educational front; while past president of NCTM, Seeley (2009), described it as the most important form of assessment a teacher can use to guide instructional decision-making and to support student learning. From this perspective, formative assessment "allows the teacher to see what needs to be clarified or explained in a different way, when to slow down, or when it's alright to speed up the pace of the lesson" (Schmoker, 2011, p. 54). Fisher and Frey (2007) indicated that knowing all students understand is far different than knowing that six or seven students, who actively participate, understand. The benefits of

including formative assessment in lessons could have as much as 20 to 30 times more positive impact on learning over the most popular initiatives, be as much as 10 times as cost effective as smaller classes, have a yield of between 6 and 9 months of additional learning growth each year, and have students learning four times as fast with its consistent use (Schmoker, 2011). Other experts also have found that the use of formative assessment has demonstrated significant and substantial learning gains (Black, Harrison, Lee, Marshall, & William, 2003, Marsh & Willis, 2007).

Summative assessment. A formal definition of summative assessment is provided by AERA (2014), which explained that assessment measures a test taker's knowledge and skills. This assessment typically takes place at the end of a program, such as an instructional unit or grade level. With this definition in mind, the purpose of such an assessment is to provide a grade or final measure of student achievement (Bailey & Jakicic, 2012; Danielson, 2006; Marsh & Willis, 2007). Insuring the consistency of a course throughout a school or district is another purpose often assigned to summative assessments (Danielson, 2006). Unlike formative assessment, summative assessments are generally developed around complex standards rather than specific learning goals or multiple standards (Bailey & Jakicic, 2012). Examples of summative assessment include final exams or projects, unit assessments, performance tasks, state tests, ACT, SAT, Advanced Placement exams, and norm-referenced or criterion-referenced tests (Bailey & Jakicic, 2012; Marsh & Willis, 2007).

AERA (2014) explained that the assessment of student outcomes is summative in function. These types of assessments can include standards-based interpretations focused on content standards or performance-based interpretations focused on content standards and the level at which students are successful with the related knowledge and skills

(AERA, 2014). Traditional summative assessments do not easily measure skills such as collaboration, oral defense of work, or science lab type activities. As a result, some standards are underemphasized for the sake of standards that are more easily measured by traditional assessments (AERA, 2014). Unintended consequences often occur with summative assessments used to inform public policy. Some of these consequences may be a narrowing of the curriculum to focus on the expected test content, a limiting of the choice of instructional practices that prepare students for the test format and content, an increase in dropout rates of students who do not pass the test, and an encouragement from instructors and administrators for practices that raise test scores without improving the quality of the education (AERA, 2014).

The characteristics of a valid summative assessment include alignment to the desired curriculum outcomes, equity for the diverse populations who will take the assessment, clearly defined performance standards, and multiple measures and methodologies so no one test carries extreme importance (Danielson, 2006). The importance placed on summative assessments often results in them being promoted as having a formative value beyond their actual use (Hill, 2010). Others believe that summative assessments can indeed have a formative impact, at least in the case where the teacher has control over when and how the assessments are used (Black et al., 2003). In a marriage of the two forms of assessment, NCTM (2001) cited the Model Assessment Program which suggests that all assessment programs include three components: on-demand tests which include basic skills tests, student work samples with rubrics or scoring guides for work evaluation, and ongoing assessment by classroom teachers through formative measures. With teachers teaching the way they were taught, examination of their instructional practices and uses of assessments is needed (Gibson &

Van Strat, 2001; Green 2014; NCTM, 2013).

Summary

One aspect to be considered closely is how coaches gain access to classrooms and how they insure that best practice is being implemented by the teachers (Gwazdauskas, 2009). Schools must consider carefully how to implement the position of instructional coach in order to maximize effectiveness (Gwazdauskas, 2009). In some instances, districts and schools establish conditions theoretically that can make coaching work well; however, even in these cases, districts, schools, and coaches still face obstacles in the designing and implementing of this type of professional development (Neufeld & Roper, 2003). In examining the available research, a variety of coaching models exist. In some cases, coaches are assigned to multiple schools and are available to the respective teachers 1-2 days per week. In other situations, coaches work with one school while focusing on a specific grade level or individual group. Still another scenario has coaches working with teachers based on teacher requests for assistance; however, the most effective situation is one in which the expectation is that teachers will work with the coach. In these cases, such a relationship is encouraged (Neufeld & Roper, 2003). As schools examine options for implementing curriculum coaches, the initiative needs to utilize coaches who have been trained in working with adult learners; facilitating and consulting with teachers; modeling, accessing, and using data; and recognizing effective instructional practices and strategies (Edmondson, 2007). Further consideration should also be given to the advantages and disadvantages of selecting a coach from the current staff versus selecting someone from outside the school (Neufeld & Roper, 2003).

As far back as Benjamin Franklin, a call has resounded for a change in mathematics instruction (Marsh & Willis, 2007). Along the way, Bruner, Vygotsky, and

Piaget have made their arguments for constructivist development theory (Marsh & Willis, 2007; Van de Walle & Lovin, 2006). This paradigm shift in instructional practice has been accompanied by changes to professional development, assessment, and teacher efficacy. These changes require support if the result is to be beneficial change. These research-based strategies can be implemented more effectively when classroom teachers are supported by curriculum coaches (Ingebrand, 2012). For those districts willing to address the practical challenges of the difficult task of curriculum coaching, great promise lies ahead (Costa & Garmston, 1994; Darling-Hammond & McLaughlin, 1995; Garmston & Wellman, 1999; Neufeld & Roper, 2003).

Chapter 3: Methodology

Introduction

This mixed-methods study was conducted because there was little previous research available regarding the impact of a math curriculum coach on instructional practice and teacher self-efficacy (McGatha, 2009; Nicometi, 2011). In this chapter, the methodology of the study is defined. A timeline and description of the phases of the study are outlined to provide the context of this study.

Research Design

Mixed-methods study of a mathematics curriculum coach versus a general curriculum coach. This study used mixed methods to investigate the impact of the role of a mathematics curriculum coach on teacher instructional practices and teacher perceptions of their instructional practices. In addition, this mixed-methods study of a mathematics curriculum coach versus a general curriculum coach included teacher self-efficacy data from the beginning of the study and the end of the study using quantitative data. A component of this study was interviews with teachers at each school. Focus group and interview questions using a proxy were open-ended addressing areas such as types of interactions with the math coach, perceptions of the relationship with the math coach, teacher perceptions of their ability to teach math, and the support they feel necessary to be successful. Teachers were also asked to address any changes they made to their instructional practice in math during the period of this research study. The quantitative portion of the study included the use of the MTEBI by Enochs et al. (2000).

Rationale for study design. This study investigated math curriculum coaches in one school district in the format of a mixed-methods study. Mixed-methods research is a blend of qualitative and quantitative methods (Creswell, 2014; Plano Clark & Ivankova,

2016). One reason for using a mixed-methods approach was the belief that combining qualitative and quantitative data creates a more complete understanding of the situation than would be created by using one of the methods alone (Creswell, 2014; Creswell & Plano Clark, 2011; Plano Clark & Ivankova, 2016). Plano Clark and Ivankova (2016) further indicated that the strengths and weaknesses of each method type offset the other. This research study was conducted from a constructivist worldview. Using open-ended questions and examination of processes and interactions between the math coach and the teachers, the researcher constructed meaning of the impact of the math coach (Creswell, 2014; Marsh & Willis, 2007). Creswell (2014) and Plano Clark and Ivankova described this approach as one where the researcher creates meaning from the collected data.

Triangulating data sources as a means to neutralize bias is one theory behind mixed-methods research (Creswell, 2014). Triangulation also serves to enhance the validity of data collected through qualitative means (Plano Clark & Ivankova, 2016). When the quantitative and qualitative data are collected sequentially, a sequential mixed-methods approach is in use (Creswell, 2014; Creswell & Plano Clark, 2011). The sequential timing provides the opportunity to analyze the data from one method and use the analysis to inform the remaining method (Plano Clark & Ivankova, 2016). This mixed-methods study provides evidence of how ongoing embedded professional development by way of an on-site math curriculum coach impacts teacher perceptions regarding their instructional practices and sense of self-efficacy. Figure 4 shows the plan for this research study following the constructivist worldview through a sequential mixed-methods design.

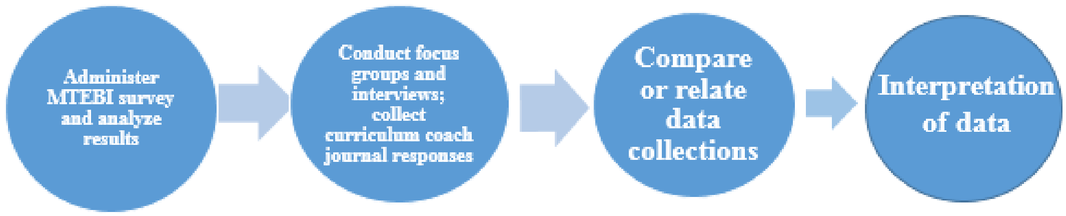

Figure 4. Research Study Design.

In the participating district, there are a small pool of coaches who are specifically designated as mathematics curriculum coaches. Although many of the schools in the districts have curriculum coaches, the typical arrangement is either there is only one coach for Grades K-5 or there are two coaches: one for Grades K-2 and one for Grades 3-5. In such a scenario, the curriculum coach covers all subject areas for that grade band. This study provides the opportunity to closely examine the roles of each curriculum coach and the differences in expectations of their positions. This study covered a period of 6 weeks.

The rationale for using a mixed-methods design aligns with Creswell's (2014) explanation that mixed-methods research yields a stronger understanding of a question than qualitative or quantitative research alone. Both forms of data were integrated in the design as the analysis of the data was merged and connections were made (Creswell, 2014; Creswell & Plano Clark, 2011; Plano Clark & Ivankova, 2016). The survey data and the interview data were collected and analyzed sequentially. This mixed-methods study sought to examine a role in education which has little previous research. Butin (2010) indicated that an exploratory dissertation design is a wise choice when studying an issue not well understood. The mixed-methods design allows for exploration of the role

of math curriculum coach from differing perspectives.

Research experts. Creswell (2014) wrote that mixed-methods research rests in the middle of the research continuum between qualitative and quantitative research. This method was a blend of characteristics of both the qualitative and quantitative approaches to research (Creswell, 2014). A mixed-methods approach to research is appropriate when the researcher seeks to achieve a more complete understanding of the research scenario than would be accomplished by choosing qualitative or quantitative methods alone (Creswell, 2014; Creswell & Plano Clark, 2011; Plano Clark & Ivankova, 2016). Sequential mixed methods allow the researcher to collect both forms of data separately, adjust questions in the qualitative phase, and report the overall results in the interpretation of the findings (Creswell, 2014). As Creswell (2014) explained, a study can begin with a survey as a means to generalize results. In this study, a survey was used to generalize teacher perceptions of self-efficacy. This survey was followed by focus groups and one-on-one interviews to gather participant views that further explained the initial survey results (Creswell, 2014). Then the survey was administered again to determine if there was a change in participant perceptions of self-efficacy.

Participants. This study involved two levels of participants. The first level of participants is the math curriculum coach: n = (number of participants); thus, n is one of the mathematics curriculum coaches within the focus school district. The general curriculum coach at the second school was also a participant. In addition to these participants, teachers at each of the schools were included in the data collection phase.

There are 26 classroom teachers at School A. The ethnic makeup of the school shows that 85% of the staff is White, 12% is African-American, and 3% is Multi-Racial. Six of the teachers hold National Board certification. Master’s degrees have been

obtained by 11 teachers. As a requirement of No Child Left Behind (NCLB) legislation, 100% of the staff is highly qualified. School B employs 29 teachers. The staff at School B is 69% White, 18% African-American, 7% Hispanic, and 6% other. Of these teachers, eight have earned National Board certification; 100% of the staff is highly qualified as defined by NCLB.

A response rate of 80% was anticipated for the surveys, focus groups, and one-on-one interviews. From these teachers, six to eight were chosen randomly to participate in focus groups and an additional four to five from each school were chosen randomly to participate in one-on-one interviews. All participants were provided an explanation of the study and the participation needed. Those coaches and teachers willing to participate signed an informed consent agreement which can be viewed in Appendix A.

Convenience sample. The sample for this research study was based on convenience. The school district involved in the research employs two teachers designated as math coaches. The researcher is one of the mathematics coaches in the district. In order to limit the bias of the results, the researcher's school was not included as a focus school. In addition, a proxy was used to administer the surveys and conduct the focus groups and interviews. This inclusion was another layer in place to limit bias, in that participants might speak more freely to a proxy than the researcher who is known as a math coach in the district. For the purpose of comparing data and teacher self-efficacy outcomes, a school in the district that employs a curriculum coach, not designated specifically for math, was included. This school was chosen based on the makeup of student population being similar to that of the focus school with a math coach as was demonstrated through the data presented in Chapter 1.

A convenience sample was chosen because focus School A is a naturally formed

group that fits into the framework of the study (Creswell, 2014). As a means to protect the validity of the results, measures were implemented to maintain the anonymity of the participants and intercoder agreement processes were used. Generalizations made from this study may best apply to groups similar in characteristics to the participants as a result of convenience sampling (Huck, 2012).

Instrumentation

For this research study, three instruments were used to collect data. The first instrument was a quantitative survey, MTEBI developed by Enochs et al. (2000). All teachers at each school were asked to respond to the survey. The mathematics coach and general curriculum coach provided feedback during this research study using journal responses. In addition, a focus group protocol was used with focus groups of six to eight teacher participants as well as in one-on-one interviews of an additional set of teacher participants.

MTEBI. A quantitative instrument was used in this research study. This survey measuring teacher perceptions of self-efficacy regarding mathematics was used at the beginning of the study as well as at the end after the qualitative data were collected. The MTEBI developed by Enochs et al. (2000) was used to measure the self-efficacy of the teacher participants. Permission was granted by Dr. Huinker to use the instrument as can be seen in Appendix B. Appendix C shows the survey statements and scoring guide.

MTEBI survey consists of 21 items. Thirteen of these items are on the Personal Mathematics Teaching Efficacy (PMTE) subscale, and eight items are on the Mathematics Teaching Outcome Expectancy (MTOE). This instrument has an alpha coefficient of 0.88 for the PMTE scale and an alpha coefficient of 0.75 for the MTOE scale according to the reliability analysis (Enochs et al., 2000). Based on the

confirmatory analysis, the two scales are independent which adds to the construct validity of the instrument itself (Enochs et al., 2000). This analysis was completed using the structural modeling program, EQS. Of the items on the survey, the PMTE statements have five that are positively written and eight that are negatively written. The eight statements from the MTOE scale are positively written statements (Enochs et al., 2000).

Curriculum coach journaling. The journal reflections of the math coaches were also used as data collection instruments. In the journals, coaches reflected upon the topics discussed and implementation of any strategies covered. The entries were reviewed to determine common themes that arose from the reflections. Appendix D includes the curriculum coach journal topics. The software Dedoose was used to code the journal responses. In order to insure the validity of the coding, an intercoder agreement process was used along with member checking. Both strategies are supported by Creswell (2014) as measures to improve validity in qualitative studies.

Focus groups and one-on-one interviews. As Creswell (2014) described, focus group interview questions were one instrument used to determine validity and reliability. As a means to check the reliability of the questions, these same questions were used in one-on-one interviews with teachers. The interview was conducted with an audio recorder, and the researcher transcribed it (Creswell, 2014). An interview protocol as outlined by Krueger and Casey (2015) was used to guide the process of the focus group interviews. Each focus group consisted of six to eight teachers. The questions were open-ended allowing for the participants to express their thoughts and opinions. This design for focus groups was based on Creswell's (2014) and Krueger's and Casey's (2015) description of parameters for qualitative interviews. Appendix E includes the protocol for focus group interviews. Part two of the protocol outlines the protocol for

one-on-one interviews.

Because validity and reliability are important aspects of research, triangulation was used to ensure the validity and reliability of the focus group/interview questions (Creswell, 2014; Creswell & Plano Clark, 2011; Plano Clark & Ivankova, 2016). For qualitative methods such as focus groups and interviews, Creswell (2014) defined validity as the process by which the researcher checks for accuracy of the findings by using specific procedures. Krueger and Casey (2015) suggested pilot-testing questions to ensure that the questions are understood. Further validity can be ensured by listening carefully to participant comments, observing the manner in which they answer the question, and asking for clarification when answers are ambiguous or unclear (Krueger & Casey, 2015). Upon conclusion of the focus group, participants were asked to verify the researcher's summary of their comments (Krueger & Casey, 2015).

Creswell (2014) defined qualitative reliability as a consistent approach on the part of the researcher to other researchers and other projects. The use of triangulated data in qualitative methods is one of the strategies Creswell (2014) suggested for verifying the validity of the data collected. For this reason, the researcher chose to include two schools in the study. In addition, Plano Clark and Ivankova (2016) indicated that triangulation is used to obtain valid conclusions by comparing the quantitative and qualitative data. For this reason, the MTEBI survey results were compared to the conclusions drawn from the focus groups and one-on-one interviews. Another strategy suggested by Creswell (2014) is member checking. This strategy was used by the researcher to verify the accuracy of themes or patterns pulled from the responses of the focus groups and interviews as well as the journal entries provided by the participants. This member checking took place as a follow-up focus group interview which provided the participants an opportunity to share

their thoughts on the findings of the study.

In order to ensure the reliability of this mixed-methods study, the researcher followed the advice of experts such as Yin (2014) and Gibbs (2007) who suggested documenting precisely each phase of the research and using reliability procedures. In this case, the researcher used an intercoder agreement where another person cross-checked the codes used for the transcripts to identify themes. Creswell (2014) indicated the cross-checking should be in agreement at least 80% of the time to have good qualitative reliability.

Research Procedures and Pilot Testing

Phases of the research.

Phase one. Prior to collecting data, participants were provided information pertaining to the nature of the study and the participation needed. All individuals willing to participate signed an informed consent agreement.

Phase two. A survey instrument, MTEBI, was administered to all teachers at the focus schools. Teacher participants were assigned a code that was only used to track the data. This survey was given during a faculty meeting at the beginning of the school year in order to maximize the number of responses. The MTEBI was administered using a paper copy. A response rate of 80% was desired to support the reliability of the information. Once the survey was administered, the data were analyzed which allowed the researcher to add questions to the focus group protocol if needed.

Phase three. Journaling and focus group interviews took place simultaneously in this phase of the research. Both coaches kept journal records of the interactions with teachers over the 4-week period during the study. Prompts were provided asking the coaches to track the length of time spent with teachers, the nature of the interaction,

topics discussed, and planned next steps. These journal reflections were completed using a digital format such as Google forms.

The researcher collected data via a proxy regarding teacher instructional practices using a focus group of teachers from each of the participating schools. Because teachers might feel pressured to agree with the group during the focus group interview, a group of teachers not participating in the focus group were interviewed individually. Teachers in the school who have a general curriculum coach were also included in a focus group and individual interviews. The interview questions with these teachers were very similar to the questions asked of the teachers at the school with the mathematics coach; however, the questions asked teachers to reflect on the kind or level of support they felt is necessary to help them be successful with mathematics instruction.

Phase four. At both participating schools, individual teachers were interviewed by the proxy using the questions asked during the focus groups in phase one. The individual interviews were used to determine the validity and reliability of the responses provided in the focus groups.

Phase five. At this stage of the research, the software, Dedoose, was used to analyze the journal reflections and interview questions. Common themes and patterns were used to draw out pertinent information.

Phase six. During this phase of the study, the MTEBI was re-administered to all teachers during a faculty meeting to compare changes in teacher self-efficacy as a result of interactions with the math coach. The results of this administration of the survey were analyzed and compared to the results of the initial survey.

Phase seven. As a means of cross-checking the data used in this study, the researcher met a final time with the focus groups and curriculum coaches. Findings of

the study were shared with the participants. The participating teachers were given an opportunity to give their feedback regarding the findings of the study. A coding system was used to track teacher responses while maintaining anonymity. All responses were housed in a locked cabinet at the researcher's home during the research period.

Data Analysis

For data analysis the researcher reviewed the quantitative and qualitative data. The quantitative data were measured using the MTEBI. The qualitative data were measured using the journal responses of the two curriculum coaches as well as the responses of the teacher participants in the focus groups and one-on-one interviews.

Quantitative data. The data from the MTEBI survey were analyzed using the scoring guide created by Enochs et al. (2000). Pre and postresponses were compared to determine if changes occurred in teacher self-efficacy during the period of this study. The scoring guide allowed the researcher to look for patterns in responses as well as measures of central tendency. The researcher reported the measures of central tendency, median, and mean based on the responses to statements from the PMTE and the MTOE sections of the survey. The possibility of outlier data existed with this survey and were included as applicable. Results from the quantitative data were used to answer the research questions.

Qualitative data. In order to analyze the qualitative data, the researcher looked for pattern matching. The software Dedoose was used to identify patterns and themes in the coaches' journal responses as well as focus group and interview responses. Triangulation of the data was also attempted as the data from the school with a mathematics curriculum coach were compared to data from a non-math coach school.

Creswell (2014) indicated that triangulation adds validity to a study as shown here:

> Triangulate different data sources of information by examining evidence from the sources and using it to build a coherent justification for themes. If themes are established based on converging several sources of data or perspective from participants, then this process can be claimed as adding to the validity of the study. (p. 201)

Through the analysis of the data, the researcher used codes as they emerged from the provided responses. This approach to coding is traditionally used with qualitative research in the social sciences fields (Creswell, 2014). Creswell (2014) indicated that intercoder agreement should be used to cross-check the codes and themes identified in the transcript analysis. This process should yield an 80% agreement between the researcher and the intercoder (Creswell, 2014).

Patterns of responses were identified based on responses to focus group interviews and individual journal reflections. Outliers – the researcher examined the data to locate outliers; however, due to the nature of the research study, outliers are not anticipated within the qualitative data. Research questions were answered based on the patterns identified in the focus group interviews and journal responses. Creswell (2014) suggested that researchers use the following eight steps to code data: (a) read all of the responses to gain a sense of the whole while jotting down ideas that arise while reading; (b) pick one transcript to read again with the question in mind, "what is this about"; (c) after completing step two from several participants, list all topics that have emerged and cluster them into columns; (d) using the list of topics, write the codes next to appropriate segments as an organizing framework; (e) use the most interesting wording as categories and group those that are interrelated; (f) abbreviate the final category and organize the

codes alphabetically; (g) arrange the database on these categories and prepare a preliminary analysis; and (h) recode the existing data as necessary.

Assumptions of the study. The researcher assumed that the mathematics coach had an impact on the instructional practice of the teachers in their building. The researcher also assumed that there was a relationship between the existence of the role of a math curriculum coach and teacher instructional practice. The researcher also assumed that the role expectations of math curriculum coaches are specific and understood by their constituents. Finally, the researcher assumed that interactions with the mathematics coach affected teacher sense of self-efficacy.

Limitations of the Study

Limitations of this study exist relating to job description and expectations of the mathematics coach as well as sample size. Teacher perceptions of the impact of the math coach on their instructional practice may have been affected by the teachers' understanding of the coach's job description and their expectations. Because there was a small number of designated math curriculum coaches in the participating district, the sample size was small and may have affected the ability to generalize findings to a broader context. In addition, the researcher is employed as a math curriculum coach in the district where the research took place. Bias does exist as the researcher believes that this role is beneficial. Another limitation is the planned time frame of 4-6 weeks between the pre and postsurvey on the MTEBI. This small window of time may have limited any change to the participating teachers' self-efficacy beliefs.

The response topics and focus group questions in this study are original. Triangulation, intercoder agreement, and pattern checking were used to improve the interval validity of these instruments. In addition, the questions asked of the focus group

participants were asked of the one-on-one interview participants in order to check the validity of the responses provided.

Delimitations of the study relate to the responses of the teachers involved in the study. The researcher had no control of the accuracy and integrity of the responses provided by the teacher participants. The researcher can only assume that the participants answered any and all questions honestly.

Summary

As indicated by Creswell and Plano Clark (2011), Creswell (2014), and Plano Clark and Ivankova (2016), a mixed-methods study was the appropriate method for research when the situation to be studied cannot be fully explained using one data source. Creswell and Plano Clark indicated that studying a small group of individuals qualitatively limits the ability to generalize conclusions. By including quantitative methods, the limitations of the qualitative procedures are offset (Creswell & Plano Clark, 2011). In this study, a mathematics curriculum coach was studied along with teachers at their school and teachers at a similar school that does not utilize a mathematics curriculum coach. The body of knowledge available on math curriculum coaches is not extensive (Poglinco et al., 2003). Using a mixed-methods approach allowed the researcher to develop a more complete view of the topic studied (Creswell, 2014; Creswell & Plano Clark, 2011; Plano Clark & Ivankova, 2016). All three of these reasons fit the situation to be considered in this research study; therefore, the framework of a mixed-methods study was chosen.

As the data in Chapter 1 indicate, each of these schools experienced high proficiency rates on the mathematics end-of-grade test scores in the year prior to the implementation of the new mathematics curriculum, Common Core State Standards. The

2 years following this implementation show a drastic decline in the proficiency of students in the area of math. This researcher sought to discover with this mixed-methods study what impact the mathematics curriculum coach had on the instructional practices of the teachers at the school where she works. The findings of this study are reported so recommendations for policy and further research can be addressed.

Chapter 4: Results

Introduction

This mixed-methods study was conducted because little previous research exists regarding the impact of a math curriculum coach on instructional practice and teacher self-efficacy (McGatha, 2009; Nicometi, 2011). The first three chapters of this study provided background information on mathematics curriculum coaches, a review of the literature that supports the theoretical framework which includes mathematics coaches and instruction, and a description of the research methods employed. In this chapter, a description of the data is presented, an explanation of how the data were analyzed is given, and the findings from the study are outlined. Quantitative data and qualitative data are reported as they relate to the questions examined in this study.

Overview

For this research study, three questions were considered. The questions were

1. What is the impact of the use of a math curriculum coach on teacher instructional practices in the area of math?
2. What is the impact of the use of a math curriculum coach on teacher perceptions of their instructional practice?
3. What is the impact of the use of a math curriculum coach on teacher sense of self-efficacy?

The results of this study are presented as they address the three research questions outlined above.

Study Participants

In this study, the first layer of participants was a math coach with less than 10 years of experience in education and a general curriculum coach with more than 20 years

of experience. Teacher participants included classroom teachers from kindergarten through fifth grade who taught mathematics. The years of experience for these teachers ranged from 3-30 years. All participating teachers were females from different ethnic backgrounds.

For this study, 26 informed consent forms and MTEBI surveys were distributed to classroom teachers at School A during a faculty meeting. Of the consent forms distributed, 12 were returned for a response rate of 46.15%. Additional attempts were made to increase the rate of participation at School A by contacting the teachers via email as well as the principal providing copies of the documents, but no additional responses were received. At School B, 29 informed consent forms were distributed to the classroom teachers during a faculty meeting. Of the materials distributed, 22 were returned for a response rate of 75.86%. As with School A, additional materials were distributed via email and through the principal to improve the response rate with no additional responses returned. The total number of participants between the two schools was 35 (n=35), which included the math coach at School A and the general curriculum coach at School B. The overall response rate of teacher participants was 63.6%.

When the focus groups were formed at each school, names for participants were randomly selected from the list of teachers who agreed to participate. The random selection of participants for the focus groups was conducted first since more teachers were needed for the focus groups. Seven teachers from School A agreed to participate in the focus group. Of the five remaining teachers who agreed to participate in the study, four of them agreed to be interviewed one on one. The focus group at School B included seven randomly selected teachers from the pool of 22 participating teachers. Four additional teachers were randomly selected from the list of teachers to participate in one-

on-one interviews. They all agreed to participate in the focus group and one-on-one interviews. The goal set forth in Chapter 3 was for each focus group to have six to eight teachers participate, which was accomplished. Four to five teachers were anticipated to participate in the one-on-one interviews, which was also accomplished.

For this study, there were two coaches participating: one from each school for a 100% response rate. At School A, the participating coach was a math curriculum coach, while School B utilized a general curriculum coach only. Both agreed to participate in this research study. Each coach submitted responses to the initial log, weekly logs, and the final reflection log.

Research Question 1

What is the impact of the use of a math curriculum coach on teacher instructional practices in the area of math? This question was answered using focus groups and one-on-one interviews with teachers and responses by the coaches in their reflection logs.

Data collection. The focus groups ranged from 45 minutes to an hour and a half in length based on the responses of the participants. The focus group for School A lasted an hour and a half, while School B's focus group was 45 minutes long. Each group was asked the same questions using the focus group protocol in Appendix E. Each focus group was videotaped and later transcribed. A proxy was utilized at School B because the researcher was employed by the school district in which this school is located.

The one-on-one interviews ranged in length from 20-30 minutes based on the detail of participant responses. Using the questions from the focus group protocol in Appendix E to insure reliability and validity of responses, the one-on-one interviews were videotaped and later transcribed. The proxy conducted the interviews for the

participants at School B.

Each participating coach completed six journal entries using a Google document, shared by the coach and the researcher. The first entry consisted of four questions regarding their years of experience, degrees, and duties and responsibilities as can be seen in the "Curriculum Coach Log – Initial Information" in Appendix D. The following four entries were reflection journals consisting of two questions requiring the coaches to explain their interactions with the teachers and plans for follow-up. The final entry required the coaches to reflect upon their interactions, their perceptions of the impact of those interactions, and goals for the future by responding to three questions. Responses to the weekly reflections ranged from 18 words to 157 words.

Data analysis. Once all interviews and focus groups were transcribed, qualitative data analysis methods were employed. When reviewing the transcripts from the focus groups and one-on-one interviews of participating teachers, transcripts were evaluated to determine excerpts that related to each of the research questions. Dedoose software was used to analyze the transcripts for codes. Dedoose provides the following explanation regarding the reliability of codes as applied:

> Dedoose Code – specific application results are reported using Cohen's kappa statistic. Cohen's kappa statistic is a widely used and respected measure to evaluate inner-rater agreement as compared to the rate of agreement expected by chance. To report an overall/global result for tests that include more than one code, we have adopted the Pooled Kappa to summarize rater agreement across many codes. Dedoose visual indicators use the following criteria for interpreting kappa values: <.50 = poor agreement, .51-.64 = fair agreement, .65 - .80 = good agreement, >.80 = excellent agreement. (Dedoose, 2017)

Prior to testing the application of codes to participant comments, training was conducted with the coders to develop a shared understanding of concepts. Intercoder reliability for codes applied to the teacher participant comments was 0.94. The goal for agreement was 0.80. The same codes were applied to responses the math coach and general curriculum coach provided during the 4-week period. When checking for intercoder agreement on these statements, the agreement rate was 0.92.

The codes used in this study are shown in Table 6.

Table 6

Shared Understanding of Codes

Codes	Shared Understanding of Codes
Duties and Responsibilities of coach	• Participant describes their perception of the duties of the coach.
Impact of Coaching Role	• Statement shows evidence of the impact of the coach on teacher's instructional practice.
Purpose of Interaction	• Statement shows an interaction between the coach and teacher(s)
• Resources and/or Manipulatives	• Statement shows the interaction between coach and teacher relates to resources of some type (articles, books, manipulatives, etc.).
• Assessment and data	• Interaction with coach focuses on assessments, formative and summative, and related data analysis to inform next steps.
• Curriculum and Instructional strategies	• Statements describe interactions between coach and teacher that involve the math curriculum and strategies for instruction.
• Miscellaneous Duties	• Statements describe interactions between coach and teacher that focus on MTSS, testing, or responsibilities assigned by the administrator
Coach working with	• Statements describe the coach working with one teacher or a group of teachers.
• One-on-one	• Statement describes the coach interacting with one teacher.
• Group/Grade level	• Statement describes the coach working with a group of teachers or a grade level.
Concerns	• Statements describe concerns regarding unclear definition of role, too many responsibilities, or other ways coach could be used.

The codes "purpose of interaction" and "coach working with" have subcodes to

better define the use of the codes. The purpose for interactions was broken down to clearly indicate the focus of interactions between the coach and teachers. The subcodes for "coach working with" were created to determine whether the coach works with teachers individually or collectively.

Table 7 shows the frequency of the application of the codes to the excerpts from School A. The frequency is broken down to show how often the codes were applied to responses from the focus group, one-on-one interviews, and the reflection logs of the math coach.

Table 7

Frequency of Code Application at School A

Codes	Data Source Type		
	Focus Group	One-on-One Interview	Curriculum Coach Logs
Duties and Responsibilities of coach	12	13	0
Impact of Coaching Role	1	4	8
Purpose of Interaction	11	4	12
• Resources and/or Manipulatives	3	1	1
• Assessment and data	2	1	7
• Curriculum and Instructional strategies	6	1	10
• Miscellaneous Duties	2	1	0
Coach working with	3	2	13
• One-on-one	1	1	5
• Group/Grade level	2	1	13
Concerns	15	8	0

When reviewing the frequency of these codes, a difference in the number of times "purpose of interaction" and "coach working with" and the total of their subcodes can be noted. This difference is due to a participant making a statement that aligned with more than one purpose. For example, one participant made the following statement: "If you

ask for resources she can give you resources and she can model the lessons and give you ideas." This excerpt mentions the coach providing resources as well as modeling a lesson which ties to the code, "curriculum and instructional strategies." In the responses by the coach, there were statements made that indicated the coach had worked with one teacher as well as a group. For example, the math coach stated, "Our first-grade team has been a challenge for me this year so to have some one on one time with them just to focus on math was good." In this statement, the coach indicated that she had concerns regarding an entire grade level, but she addressed those concerns one on one as well. At School A, the teacher participants made 25 statements regarding the duties and responsibilities of the math coach and 23 statements regarding their concerns about the role. Teacher participant comments about the duties of the coach range from "I don't think we know what that really is," to "They go to meetings monthly with other math coaches learning new strategies to teach, do research to learn new ways to teach us, and be in our classrooms."

Also considered when analyzing the data were the responses by the math coach regarding her interactions with the participants. The math coach indicated, "I have seen many teachers embrace number talks in their rooms, implementation of 3-Act tasks, math talk, less drill and kill, etc." This response was provided in the reflection log when the coach was asked what the perception was of a teacher's reception to working with the coach. The coach added that teachers were now running math groups in their classrooms as well. A final change the coach indicated was that teachers were talking about the math standards during planning and were looking for the best pedagogical approach when teaching these standards. The math coach indicated that this was a change, because in the past, the teachers had started their discussion by looking at an activity and deciding what

standard fit next. Finally, the math coach also indicated that assessment data in one particular grade level show that changes they had made were working.

The responses provided by participants at School B received the same codes. The frequency of these codes can be seen in Table 8.

Table 8

Frequency of Code Application at School B

Codes	Data Source Type		
	Focus Group	One-on-One Interview	Curriculum Coach Logs
Duties and Responsibilities of Coach	16	20	0
Impact of Coaching Role	6	15	3
Purpose of Interaction	7	14	20
• Resources and/or Manipulatives	3	6	1
• Assessment and data	0	0	3
• Curriculum and Instructional strategies	1	12	13
• Miscellaneous Duties	3	2	5
Coach working with	5	11	20
• One-on-one	2	11	12
• Group/Grade level	3	0	8
Concerns	10	19	0

During the focus groups and one-on-one interviews, participants spoke often of their perceptions of the duties and responsibilities of the general curriculum coach, in some instances indicating that they were unsure of the assigned duties and responsibilities. The participating teachers were also able to discuss interactions with the coach while outlining the purpose of the interaction. The code, “purpose of the

interaction," was applied 21 times to both focus group and one-on-one interview excerpts. This same code was applied to coach responses 20 times. The most frequently applied subcode was "curriculum and instructional strategies" which was applied to 13 excerpts from the teacher participants and 13 excerpts from the coach. Of the codes applied to teacher excerpts, "concerns" was applied 29 times as teachers expressed such concerns as the coach had too many responsibilities to be effective. Table 8 also shows that teachers spoke more about the impact of the role of the coach during one-on-one interviews than did the teachers participating in the focus groups.

As with School A, the general curriculum coach at School B provided responses to weekly logs which were analyzed. This coach indicated that she had seen changes to classroom behavior during instruction and increased student engagement. In light of the mathematics instruction, the coach indicated observing, "anticipation of misconceptions students' might have, more effective and efficient planning for small group instruction, focusing on the 'big ideas,' and giving more timely and meaningful feedback to students." Although the general curriculum coach indicated that these changes were observed during the math block, student misconceptions and big ideas are the two that directly tie to math content understanding. The other changes observed relate to classroom management and teacher preparation.

A comparison of the impact of the coach on teacher instructional practices regarding math was based on the responses of the two curriculum coaches and the teachers. The responses were from six logs with four of the logs directly reflecting the coaches' interactions with teachers during the study. The excerpts from the coaches and the teacher participants coded with "purpose of the interaction" and "impact of the role of coaching" shared connections such as

references to instructional strategies and review of math curriculum. For example, Teacher 4 at School A explained that the math coach helped the teacher implement new ways to teach lessons: "Things that I never would have thought of." Teacher 4 further explained that the math coach modeled using Math Talks in the classroom, asking the coach to return to the class and watch Teacher 4 using Math Talk to determine if implementing it correctly. Teacher 3 from School A made similar statements regarding the use of Math Talk as a result of working with the math coach. When asked what positive changes to your instructional practice have you made as a result of working with the math coach, Teacher 3 responded, "I do incorporate Math Talk."

In contrast to School A, School B's participants indicated in their comments that the impact they recognized was dichotomous. Either they felt that the curriculum coach provided them with the necessary resources needed to teach math or was helpful with literacy concerns or intervention plans more so than math. The impact Teacher 1 at School B recognized from working with the coach was, "A change to my reading instruction with the help of the curriculum coach." In contrast, the general curriculum coach cited interactions with teachers that included math curriculum or instructional strategies. For example, the general curriculum coach indicated she had a "Conversation with teacher regarding comparison of fractions and placement on a number line." The impact of the two curriculum coaches on teacher instructional practices varied as did teacher perceptions of the impact. Further attention was given to teacher perceptions of the impact of the coach using the second research question.

Research Question 2

What is the impact of the use of a math curriculum coach on teacher perceptions of their instructional practice? This question was also answered using the focus group protocol and one-on-one interviews. These questions can be viewed in Appendix E. Teachers were asked questions regarding their interactions with the math coach or general curriculum coach. They were also asked what impact, positive or negative, these interactions had on their instruction in math. Questions 7, 8, and 10 specifically relate to teacher perceptions of how their work with the coach affected their instruction. The responses ranged from changes made to their instruction, such as using Math Talk or math games for instruction, to no impact positive or negative. Table 9 includes the questions that relate to the research questions and provides samples of quotes from participants that convey the overall perception of participants from School A.

Table 9

Focus Group and Interview Questions – School A

Questions	Sample Quotes
What is the first thing that comes to mind when you hear "math curriculum coach" (curriculum coach)?	"A person being able to provide the resources for teachers." "Resource – someone who is there to support us."
What are the duties and responsibilities of the math coach (curriculum coach)?	"I don't know what our math coach's job is here." "Give us resources to help better assist our students in math and also lead us on what we should be doing with our students in math."
Tell me about the first time you worked with the math coach (curriculum coach).	"They come in and they're sharing with us maybe some new strategies or something like that that they went to workshops for."
What positive changes to your instructional practice have you made as a result of working with the math coach (curriculum coach)?	"New ways to teach lessons. Things that I never would have thought of. . . ."
What negative impact has working with the math coach (curriculum coach) had on your instructional practice?	"I wish there was more time," "I wish she could be more present in my room."
What has helped you grow in your teaching of mathematics?	"Somethings come from peers, professional development and peers."
How has the math coach (curriculum coach) helped change your experience with math?	"For me it's a lot of finding those resources and her sharing those resources because she's been to different professional developments."
Describe the support you feel is needed from the math coach (curriculum coach) to help you be successful teaching math.	"I would like to see her be more in the classroom with us as she coaches along or pulls small groups."
If you could give advice to decision-makers regarding the use of a math curriculum coach (curriculum coach), what advice would you give?	"Having a list for us of what their duties are to do would be very helpful."
What would you like me to know about a math curriculum coach that was not addressed by the previous questions?	"They are helpful. They are helpful if they are doing their job in what I think is the correct way. Again that goes back to people specifically outline what their job is."

Table 9 displays statements made by participants that reflect the most often conveyed thoughts of all participants at School A. The questions that asked about the positive and negative impact of the coach as well as how the coach has helped change your experience with math were first reviewed for teacher perceptions of the impact of the coach. The sample quotes reflect most statements made by the participants. When asked about the positive impact of the math coach, other comments reflected conversations that were held with the coach and suggestions from the coach that pushed teachers out of their comfort zones. More than one participant also indicated that using Math Talks in the classroom was a by-product of the work with the math coach. As Table 9 shows, most participants at School A indicated that the negative impact was the math coach being unable to be in the classroom more. Other comments also referred back to the role being poorly defined as a negative. Even though some teachers indicated that the math coach did not personally help change the teacher's experience with math, follow-up comments included the sharing of articles or resources that did have an impact on the classroom. Instances also occurred in the transcripts where the participants cited similar experiences such as modeled lessons or shared resources to address other questions. These statements were considered with the first research question.

Table 10 displays statements made by participants from School B that reflect the most often conveyed thoughts of all participants. The questions inquiring about the positive and negative impact of the coach as well as how the coach has helped change teacher experience with math were first reviewed for teacher perceptions of the impact of the coach. The sample quotes reflect most statements made by the participants.

Table 10

Focus Group and Interview Questions – School B

Questions	Sample Quotes
What is the first thing that comes to mind when you hear "math curriculum coach" (curriculum coach)?	"Somebody who should make sure teachers feel comfortable teaching the curriculum that they are meant to. And someone who should make sure that the teachers have said resources."
What are the duties and responsibilities of the math coach (curriculum coach)?	"Checking in with me, doing model lessons, observing, giving feedback . . . "
Tell me about the first time you worked with the math coach (curriculum coach).	"Mostly she just checks in with us, where we're at, what we need. She shares a lot of stuff that comes from county meetings."
What positive changes to your instructional practice have you made as a result of working with the math coach (curriculum coach)?	"Well being able to get the materials that I may need for my class has been helpful."
What negative impact has working with the math coach (curriculum coach) had on your instructional practice?	"None." "I don't know what a curriculum coach is supposed to do."
What has helped you grow in your teaching of mathematics?	"Teammates, professional development"
How has the math coach (curriculum coach) helped change your experience with math?	"It has not, cause it's focused more on reading. We have not really dealt with math."
Describe the support you feel is needed from the math coach (curriculum coach) to help you be successful teaching math.	"I am honestly successful by myself."
If you could give advice to decision-makers regarding the use of a math curriculum coach (curriculum coach), what advice would you give?	"If the curriculum coach's job is to help coach the curriculum, then you need to let them do that and not give them all these other responsibilities."
What would you like me to know about a math curriculum coach that was not addressed by the previous questions?	"It would be very helpful to have someone who could show me how to do a certain lesson. Or I'm really struggling to teach this standard, what can we do?"

Table 10 shows a representative quote for questions 4-13 from participants at School B. Most frequently, teachers responded that the positive change to their

instructional practice in math was having the resources they needed for math. One participant stated that a positive change to mathematics instruction had not been experienced because her interactions with the general curriculum coach were in reading. “A change to my reading instruction with the help of the curriculum coach,” was the participant’s response to Question 7. When responding to question 8 regarding negative impact, participants indicated they did not know what the curriculum coach was supposed to do, there was no negative impact, or paperwork related to MTSS. One other participant also mentioned a need for being proactive with the curriculum coach rather than the coach coming to them first. With Question 10, participants again cited the general curriculum coach’s role being focused more on reading and not dealing with math.

School A participants were more likely to cite experiences where the math coach modeled lessons, provided assistance with assessment data, participated in PLCs, or presented professional development. Of the 11 teachers who participated in the focus groups and interviews, modeling lessons was mentioned 18 times. Assessments and data were mentioned 11 times. PLCs and professional development were cited 17 times. Statements related to resources and materials were made 13 times.

Looking for experiences with the curriculum coach at School B, the teachers did not mention having experience with lessons being modeled by the curriculum coach. Assessments and data were mentioned three times. PLCs and professional development were discussed four times, while resources were highlighted 12 times. School B participants indicated that the curriculum coach either had no impact on their instruction seven times, had more impact related to reading five times, or was involved in planning interventions for struggling students nine times.

Teachers at both schools were asked how their respective coach helped change their experience with math. During the focus group at School A, one participant stated, "For me it's a lot of finding those resources and her sharing those resources . . . Because she's been to different professional developments." In some interviews, the participant would state that working with the coach had not changed their experience with math; however, as the participants continued to talk, they would point out that the math coach had provided "new ideas," "a focus on vocabulary," or "sharing articles or videos." Each participant indicated that they implemented these things in their math instruction.

When teachers at School B were asked how the curriculum coach helped changed their experience with math, the participants perceived that the curriculum coach had not impacted their math instruction. Participating teachers stated similar expectations for the role as those expectations from School A; however, the discussion of what actually took place was different. Teacher 2 stated that the coach had "focused more on reading. We have not really dealt with math." Other teachers echoed this sentiment.

Participants at School A were more likely to perceive that working with the math coach had an impact on their instructional practice than the participants at School B. The MTEBI survey was then analyzed to determine what changes occurred in teacher self-efficacy when teaching mathematics.

Research Question 3

What is the impact of the use of a math curriculum coach on teacher sense of self-efficacy? Participant sense of self-efficacy was measured using the MTEBI survey. The survey is scored in two parts. Thirteen of the items are part of the PMTE scale which ranges from one to five (Enochs, et al., 2000). The MTOE scale consists of eight statements. Each subset contains statements written in positive form as well as some

statements written in negative form (Enochs et al., 2000). Items 1, 2, 4, 5, 7, 9, 10, 11, 12, 13, 14, 16, and 20 were worded positively using a Likert scale ranking of 1 to 5. Items 3, 6, 8, 15, 17, 18, 19, and 21 were negatively worded; thus, scoring the Likert scale was reversed using a rank of 5 to 1 (Enochs et al., 2000). The PMTE score was created using Items 2, 3, 5, 6, 8, 11, 15, 16, 17, 18, 19, 20, and 21. The MTEO score was determined using the remaining items (Enochs et al., 2000).

School A had 11 participants from a staff of 26 respond to the presurvey for a participation rate of 42.3%. School B had 22 participants from a staff of 29 respond to the presurvey for a participation rate of 75.8%. For the postsurvey, School A had 10 participants respond for a participation rate of 38.4%. School B had 20 participants respond to the postsurvey for a participation rate of 68.9%. When changes from the presurvey to the postsurvey were analyzed, only participants who completed both surveys were considered.

PMTE. For all administrations of the survey, the scores for the PMTE portion were in the top half of the possible scores. PMTE scores ranged from 13 to 65. This score indicates that participants have a high level of self-efficacy when teaching math. Table 11 shows scores of School A participants from the presurvey to the postsurvey for the PMTE measure of the survey.

Table 11

School A PMTE Scores from MTEBI

Participant	Presurvey Score	Postsurvey Score
A1	51	54
A2	46	44
A3	50	50
A4	60	61
A5	49	48
A6	46	46
A7	47	45
A8	44	56
A9	50	48
A10	51	51
A11	47	
Mean Score	49.18	50.30

At School A, participant scores on these items indicate a high level of self-efficacy when teaching mathematics, as their scores fell in the top half of all possible scores on this scale. Participant A4 had the highest PMTE score on the pre and postsurveys. Participant A8 had an increase of 12 points on the PMTE score. Closer examination of a possible cause for this drastic change will be explored later. Of the other participants, the change in score was ±2. Participant A11 did not provide a response to the postsurvey, although multiple attempts were made to gain a completed survey.

Table 12 displays the PMTE scores for participants at School B.

Table 12

School B PMTE Scores from MTEBI

Participant	Presurvey Score	Postsurvey Score
B1	56	60
B2	59	57
B3	45	50
B4	49	50
B5	56	59
B6	55	50
B7	53	46
B8	49	49
B9	51	49
B10	41	39
B11	38	48
B12	48	50
B13	45	50
B14	54	52
B15	47	52
B16	52	53
B17	49	48
B18	42	46
B19	46	52
B20	42	
B21	48	50
B22	46	
Mean Score	48.68	50.50

At School B, Participants B20 and B22 did not participate in the postsurvey. Multiple attempts via email and school administration did not yield a response from these participants. Most participants were within ±5 points of their presurvey score. Participant B11 had an increase of 10 points from the presurvey to the postsurvey. Unlike School A, this pool of participants did not result in the same person having the highest score on the scale for the presurvey and the postsurvey. These participants also had a high level of self-efficacy regarding mathematics according to this survey.

MTOE. Possible scores from MTOE range from 8 to 40. High scores from these items indicate the respondent has a high expectancy for outcomes from their mathematics

teaching. Table 13 shows the scores for participants from School A on the MTOE items.

Table 13

School A MTOE from MTEBI

Participants	Presurvey Score	Postsurvey Score
A1	26	25
A2	27	24
A3	29	28
A4	33	31
A5	28	28
A6	25	25
A7	32	28
A8	29	25
A9	28	30
A10	27	28
A11	27	
Mean	28.27	27.20

All participants at School A have scores in the upper half of the range of scores for the MTOE items. The scores change from the presurvey to the postsurvey by ±4 or less. Participant A4 had the highest score on the presurvey and the postsurvey. When comparing the scores of all participants, they are all within eight points of each other. There is no one participant who stands out as having an extremely high or low level of expectancy.

Table 14

School B MTOE from MTEBI

Participants	Presurvey Score	Postsurvey Score
B1	26	30
B2	22	26
B3	31	32
B4	30	33
B5	27	29
B6	32	32
B7	29	29
B8	24	31
B9	28	31
B10	20	24
B11	29	28
B12	24	28
B13	28	26
B14	21	30
B15	23	17
B16	32	30
B17	24	29
B18	25	27
B19	28	28
B20	26	
B21	22	22
B22	27	
Mean	26.27	28.10

While two teachers at School B scored in the bottom half for MTOE, all other participants scored in the top half for this measure. At School B, Participant B15 had a six-point drop in the MTOE score. This drop places the MTOE score just below the middle of the range for possible scores. From the presurvey to the postsurvey, each administration had a different participant having the highest score. Participant B14's score increased by nine points from the presurvey to the postsurvey.

Measures of central tendency and variance. In Table 15, the measures of central tendency from the survey are compared. Variance of the scores for each scale is also included in this table.

Table 15

Comparison of Measures of Central Tendency and Variance

	Mean PMTE	MTOE	Median PMTE	MTOE	Mode PMTE	MTEO	Range PMTE (13-65)	MTOE (8-40)
School A								
Pre	49.18	28.27	49	28	46, 47, 50, 51	27	44-60	25-33
Post	50.30	27.20	49	28	48	28	44-61	24-31
School B								
Pre	48.68	26.27	48.50	26.50	49	24, 28	38-59	20-32
Post	50.50	28.10	50	29	50	28, 29, 30	39-60	17-33

For School A, there was less than one point difference in the mean score from the initial survey to the postsurvey for the PMTE scale and approximately one point difference in the mean score for the MTOE scale. For School B, Table 15 shows that the mean scores for both scales changed by nearly two points from the first administration of the survey to the second. These small changes indicate that there was little change in teacher self-efficacy regarding mathematics instruction during the brief period of this study. All other measures of central tendency fall within the same range of the mean. Although the difference in the range of each set of scores is as much as 20 points, the scores are in the upper half of the possible scores for the PMTE and the MTOE scales.

Items to note. While reviewing the individual questions and scores, some instances of interest were noted. Question 1 which affected the MTOE score showed multiple participants whose scores changed from one end of the scale to the other from the presurvey to the postsurvey. The question stated, “When a student does better than

usual in mathematics, it is often because the teacher exerted a little extra effort." This statement used positive wording using a scale of 1 (strongly disagree) to 5 (strongly agree). When participants took the survey, they circled letters SD, D, N (neutral), A, SA. The number codes were applied during analysis. Table 16 shows participants' presurvey and postsurvey results for question 1 for participants whose response score shifted from positive to negative between the presurvey and the postsurvey.

Table 16

Question 1 Responses

Participants	Presurvey Response	Postsurvey Response
A3	4	2
A4	5	1
A7	5	1
A8	5	1
A10	2	4
B12	4	2
B17	2	4
Total	27	13

As can be seen in the table, the sum of the scores for this question vary by 14 points. Participants A3, A4, A7, A8, B12, and B17 all show a change from a score near the positive end of the scale to the negative end of the scale. Participant A10 changed the response from a negative to a positive. Because the participants were not provided an intervention between the two surveys, one would not expect the scores to change to this extent. Such a change in scores could be a misunderstanding of the question during one of the administrations.

Another interesting point in the results from MTEBI is Participant A8's responses. On questions 1, 5, 16, 17, and 20, Participant A8 flipped the answers to the questions from one end of the scale to the other. Table 17 displays each of these

questions and Participant A8's responses on the pre and postsurvey.

Table 17

Participant A8 Responses

Question	Responses Presurvey	Responses Postsurvey
1. When a student does better than usual in mathematics it is often because the teacher exerted a little extra effort.	5	1
5. I know how to teach mathematics concepts effectively.	1	5
16. I am typically able to answer students' questions.	1	5
17. I have the necessary skills to teach mathematics.	5	1
20. When teaching mathematics I usually welcome student questions.	1	5

The flip for each of these statements is not consistent. For statements 1 and 17, the participant strongly disagreed on the postadministration. On items 5, 16, and 20, Participant A8 strongly agreed with the statements. Such a drastic change in the responses raises the question of whether the participant understood the statements. Another thought to consider might be that the change is due to the surveys being given on a day where there was a challenging situation during the math lesson which affected the participant's responses to these questions; however, the actual cause of the change is unclear without discussing the answers with the participant.

School B had two participants whose rating for three items changed from one end of the scale to the other. Participants B8 and B12 were the two participants; however, their change in ratings only matched on question 13. This statement asked the participant to rank, "Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching." On the presurvey, these participants disagreed

with this statement; whereas on the postsurvey, the participants agreed with it. Again, one must consider whether the participants understood these statements.

One final consideration is statement 13 at School B. This statement asks participants to rank their agreement to the following, "Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching." There were a total of four participants whose ratings changed from disagreement on the presurvey to positive rankings on the postsurvey. Without talking with the participants directly, the reason for the change is unclear. A general misunderstanding of the statement by these participants must be assumed.

Summary

The results of this research provided a variety of data points which yield perspective on math coaches. The participants at both schools were able to identify opportunities where they worked with the coach. Although some responses to questions indicate that the teachers felt there has been little to no impact on their instruction, they also cited use of materials, instructional strategies, and modeled lessons from the coach in their practice. School A's math coach indicated that assessment data support a positive impact on math instruction at the school.

The perception survey for self-efficacy when teaching math shows no real change in teacher responses from the presurvey to the postsurvey. Any changes reported by the responses were less than five points, positive or negative, for more than half of the participants. Survey results were consistent at both participating schools.

By examining each research question individually, Chapter 4 has examined the quantitative and qualitative data used to respond to these questions which guided this study. Important insights developed from this study were the role of the math coach

needs to be clearly defined; working with the math coach did have an impact on teacher instructional practices; and teacher perceptions of self-efficacy did not change over the course of this study. In Chapter 5 the findings of the study are connected to the current body of knowledge in order to make recommendations for future research, policy, and practice.

Chapter 5: Conclusions

Introduction

This mixed-methods study was conducted because little previous research exists regarding the impact of a math curriculum coach on instructional practice and teacher self-efficacy (McGatha, 2009; Nicometi, 2011). As the data were analyzed, codes and themes emerged that should be considered moving forward. In this chapter, a summary of the results is given; findings are reported; and recommendations for practice, policy, and further research are made.

Summary of the Study

Collection of the data. Using focus groups and one-on-one interview responses, coach reflection logs, and MTEBI survey results, this research sought to determine whether math curriculum coaches have an impact on teacher instructional practice. Three research questions were used to guide the research.

1. What is the impact of the use of a math curriculum coach on teacher instructional practices in the area of math?
2. What is the impact of the use of a math curriculum coach on teacher perceptions of their instructional practice?
3. What is the impact of the use of a math curriculum coach on teacher sense of self-efficacy?

This 6-week study began by administering the MTEBI survey at both participating schools and having the respective coaches submit a response to the initial curriculum coach log which indicated the years of experience each had in education, the degree(s) held, and their responsibilities as coach. After analyzing the survey results, the

researcher began conducting focus groups and one-on-one interviews with teacher participants. During the next 4 weeks, the math coach and general curriculum coach submitted weekly responses to the logs found in Appendix D. At the end of the 4-week period, the MTEBI survey was again administered to participants and each coach completed a reflection log that focused on their perceptions of the work they had completed in the previous weeks and where they would like to go with future interactions.

The findings. The researcher found that the math curriculum coach at School A did have an impact on teacher instructional practices. Teacher participants indicated that they worked with the coach during weekly PLCs. Most teachers also described experiences with the math coach which included the coach modeling lessons or observing lessons to provide feedback. At School B, participants described interactions with the general curriculum coach involving discussions of interventions for struggling students or concerns with English language arts. Teachers at School B indicated the interactions with the general curriculum coach that related to math dealt more with the availability or locating of resources. At both schools, teachers expressed concerns of the coach being more available, working with small groups, or having a more clearly defined role.

The results of the MTEBI survey showed little variance over the 6-week study period. Changes to teacher sense of self-efficacy were 5 points or less on average on their total scores. Overall, the teacher participants held high levels of self-efficacy when teaching mathematics. They also had high levels of outcome expectancy related to student performance in math.

Interpretation of the Findings

In the current research, Confer (2006), Bean and DeFord (2012), and Valente

(2013) indicated that the role of math curriculum coach can have many descriptions or often is not defined clearly. Responses from participants during the focus groups and one-on-one interviews support the findings of this research. Participants expressed a variety of different ideas of what the coach should be doing in their role. Six different comments also confirmed the notion that the role is poorly defined. Participants made statements such as, “I don’t think we know what that really is,” in response to the question regarding the duties and responsibilities of the coach. Along with the research stating that the job was ill defined, studies by Obara and Sloan (2009), Edmondson (2007), Debacker (2013), and Rapcki and Cross-Francis (2014) indicated that such poorly defined roles also create obstacles for the coach working with teachers. Participants in this study also confirmed this finding by expressing hesitation when seeking help from the coach due to the uncertainty of her responsibilities. One participant said, “You know I might not feel comfortable going and asking ours to help me with something if that’s not what she’s supposed to be doing.” She went on to say, “I don’t want to blind-side ours.”

Debacker (2013) also stated that coaches have difficulty fulfilling their role of assisting with instruction when assigned too many tasks that are not directly related to instructional coaching. At School B, the curriculum coach indicated in the reflection journal that student observations were done during the math block and follow-up was needed. In the next response, the coach stated, “haven’t had time to follow-up yet with the teachers.” The coach’s response indicates that assigned responsibilities have prevented timely follow-up with the teacher. At School A, teacher participants expressed agreement with Debacker’s findings four times. The participants at School B agreed with the findings 11 times. One participant made the statement, “If the curriculum coach’s job

is to help coach the curriculum, then you need to let them do that and not give them all these other responsibilities."

Another concern that emerged during the focus groups and one-on-one interviews was related to the choice of the math coach. Neufeld and Roper (2003) explored the advantages and disadvantages to using a math coach from the staff at the school. Although the math coach at School A was hired from the pool of teachers at the school, participants expressed concerns about that move. Participants expressed their perceptions in similar ways to the following:

> To be honest this is something I've heard several teachers say, "I don't know what our math coach's job is here." This is a position that kind of just popped out of the air. No one knew about it and we were like "Oh we're getting a math coach." Well we didn't know that was going to be an option so it's like just sprung on us like as a teacher being here for . . . And I've been at this school for 18 years too. It was never brought up to the staff.

Other negative statements include participants expressing, "She used to be a classroom teacher who was just pulled out of the classroom and picked randomly to be the math coach. . . . We were told about her job and it wasn't like anyone was asked to do it." Although these participants cited examples of using resources or strategies shared by the math coach, statements such as these indicate that resentment existed with the use of this teacher as School A's math coach.

A variety of benefits can be experienced through the use of a math coach. Curry (2017) stated that a math coach who has vast math content knowledge can support classroom teachers as well as instruct small groups or one-on-one situations with targeted students. Curry further stated that the ultimate goal is to improve the math proficiency

levels of students and adults. At School A, participants cited a desire to have the math coach provide instructional support to small groups 18 times. These participants believed that the math coach needed to support them by working with small groups of students.

The professional learning model is an ongoing, in-depth systematic process in which an individual invests him/herself in such a way as to create professional knowledge (Easton, 2008; Timperley, 2011). Professional development is designed to improve student learning through improving teacher knowledge and instruction (Doerr et al., 2010). Professional development is not sustained in the way professional learning is. Professional development is typically fragmented and episodic (Sztajn et al., 2011). Participants in this study indicated that the existence of the math coach allowed them to watch the math coach in action in the classroom. One participant explained interaction with the math coach by saying,

> I'm simply going to do this Math Talk and that's the way it's going to be. That was a very uncomfortable thing for me. And to have her come in and do a sample lesson. She did that in each of the kindergarten classes. And I said, "I'm still not comfortable. I'd like you to come in and do it several times." And after I watched her, I asked her to come back and watch me do it and say, "Am I doing it right?"

The participant went on to explain that the ability to continue working with the math coach on this topic helped her feel more comfortable. Such an interaction would not be possible if the teacher had only been to a professional development session on Math Talk. A second participant shared her thoughts saying, "Often she will support us and when we are rolling out a new standard, she will help us to stay . . . To present it properly so you don't have to reteach." Timperley (2011) indicated that the focus of professional learning

seeks to assure the knowledge and skills developed during professional learning meet immediate and future challenges of teaching and learning. By assisting this participant in presenting a standard properly, the math coach was exhibiting the goal of professional learning as outlined by Timperley. The math coach also indicated in the reflection log that student assessment data were showing that the changes to instruction were resulting in improved student understanding. The curriculum coach of School B also indicated that teachers stated that math was being taught in ways not previously considered. These statements were a result of the coach working with teachers on their instructional practice. This sustained support provided by the math coach would not be possible had these instructional changes been introduced during traditional professional development. The teachers would have been left to implement the instructional changes in the classroom without the benefit of follow-up.

Research Question 3 addressed the participants' sense of self-efficacy when teaching mathematics. Bandura (2006) defined self-efficacy as a person's ability to take actions necessary to achieve a desired outcome. Using the MTEBI survey, participant levels of self-efficacy were measured. Scores on the PMTE portion of the survey range from 13 to 65. With scores in the upper half of the range for PMTE, participants showed high levels of self-efficacy related to teaching math with scores higher than 39. Only one participant had a score lower than 39 with a PMTE score of 38. Although their levels were high, participants expressed concern that they needed help. During the focus group, one participant stated, "Knowing that we are lacking a curriculum, lead us down a path." Another participant expressed the following concern:

> This school, it takes a village and to me it takes every available body working with children across the board because these kids come in from kindergarten, they

come in struggling. We're going like this to try to catch them up.

Ross (1992) and Tschannen-Moran et al. (2008) believed that self-efficacy is an individual influence rather than a collective one. Rotter (1966) set the precedent by indicating that teacher efficacy is powered by belief that factors under the teacher's control have greater influence than external factors. Because these participants have concerns that they are not receiving enough assistance with their students, their high levels of self-efficacy do not match the parameters set by experts such as Rotter and Bandura. Participant comments during the focus groups and interviews seem to focus on the obstacles over which they have no control.

Limitations of the Study

Creswell (2003) defined limitations in research as weaknesses of the study. One limitation of this study is related to the lack of a clear job description and expectations of the mathematics coach. The impact of the mathematics coach was influenced by teacher perceptions of the role and responsibilities of the mathematics coach. Due to the limited number of mathematics coaches assigned to a single school, the sample size was small and caused the researcher to use caution when generalizing the findings to broader contexts. School B is located in the district in which the researcher is employed, resulting in a proxy being used for the focus groups and one-on-one interviews. The planned time frame of 4-6 weeks between the pre and post MTEBI survey was a limitation as well. The time frame of the study did not provide enough time for a change to their efficacy to take place. Participant understanding of survey items limited the results of the survey data.

Using original response topics for coach response logs and focus group questions was a limitation. This limitation was caused by the fact that the topics and questions had

not been used in a research study prior to this study. Intercoder agreement, pattern checking, and triangulation were employed to improve the validity of the responses of the participants. Prior to applying codes to the interview transcripts and coach reflection logs, training was provided regarding the codes and their meaning. Intercoder agreement on codes applied to the focus groups and one-on-one interviews was 0.94. When applying codes to coach reflection logs, the intercoder agreement was 0.92. The math coach's response log was compared to that of a general curriculum coach. Teacher participants were questioned using a focus group format or one-on-one interview to compare the responses of the participants. These steps improved the internal validity as patterns emerged from the responses of all participants.

The responses of the teachers involved were an additional limitation of this study. The accuracy and integrity of participant responses were out of the control of the researcher. As a result, the researcher could only assume the participants answered each question honestly.

Delimitations are defined as ways "to narrow the scope of the study" (Creswell, 2003, p. 148). This study was 6 weeks in length. Such a short period of time narrowed the scope of this study. One result of this narrowing was insufficient time for teachers to experience a change in self-efficacy. In addition, the scope of the study was a delimitation due to the small number of schools utilizing the role of math coach assigned to the single school within the southeastern state where the two participating schools are located. One school employed a math coach, and the other school employed a general curriculum coach. By utilizing two schools, the impact of the role of math coach was delimited such that results cannot be broadly applied but generalized to schools similar to the schools in this study.

Recommendations for Further Research

Policy. This study provides two recommendations regarding the role of mathematics curriculum coach. Based on this study, the researcher recommends that the role of mathematics curriculum coach be maintained. The researcher further recommends that the role of the mathematics coach be clearly defined for the coach and the teachers with whom the coach works.

With dollars for education spending being so tightly allotted, further study is needed to determine whether the role of the math coach is truly beneficial in light of the cost of the role (Ezarik, 2002). Questions to consider should relate to the cost of employing a math coach in comparison to other ways to spend those same dollars, as a cost comparison to check the return on investment. Benefits of the math coach should be considered; including that with a math coach, teachers integrate new approaches more easily. Numerous participants in this study indicated that they were using instructional strategies modeled by the math coach. They also explained that seeing the coach model these ideas was more beneficial to them than reading about them or watching a video.

Research. This study was conducted over a 6-week period using two schools. Although the information gleaned from this research can add to the body of existing research on this topic, further research might follow these teachers and coaches over a longer period of time. By using a longitudinal study of 1-3 years, research could not only follow the work of the teachers and the coaches, but student achievement data could be included as well. Another advantage to extending the length of the study period would be to monitor teacher self-efficacy regarding teaching math over a longer period of time. Even if specific interventions had been implemented, a 6-week period of study makes it difficult to truly determine any changes to teacher perceptions of their teaching of

mathematics.

During this study, the coaches were asked to complete a reflection log each week which highlighted their interactions with the teachers and how receptive the teachers were to these interactions. The coaches also outlined plans for next steps with the teachers. To provide more insight into these interactions, participant teachers could also complete weekly reflection logs regarding their interactions with the coach and their plans for next steps. By completing the logs in a parallel manner, the researcher would be able to compare teacher perspectives with those of the math coach. Also useful to the study might be video recordings of the interactions with teachers. These recordings could be analyzed for consistency of interactions and teacher receptiveness and body language as well as tracking the length of time actually spent on coaching and the focus of the coaching.

If future findings are to be generalized in a broader context, another point to consider would be to study the role of a math coach in multiple schools. Currently, this study and the results could be generalized to schools of similar size and makeup; however, because the number of participating schools is so small, the results may not be expected at schools with differing sizes and demographic makeup. Also, one might consider using participating schools in different districts. Enlarging the pool of participating schools would improve the reliability of the results. By enlarging the pool of math coach participants, further study could be done to analyze the duties and responsibilities of the coaches at different schools. Are the coaches used in the same way from one school to another? If there is a difference, does one coach seem to be more successful with their interactions? Can a reason for the success be pinpointed? Have the coaches received training to support them in their role of coaching teachers?

This study employed the use of focus groups and one-on-one interviews. The focus group design was chosen because a focus group is useful when gathering opinions. These groups are also beneficial when the participants feel they are in an environment where it is safe for them to express their opinions on a given topic (Krueger & Casey, 2015). Krueger and Casey (2015) also indicated that a focus group works well when exploring "perceptions, feelings, and thinking about issues, ideas, products, services, or opportunities" (p. 7). This purpose fit the intent of this research study; however, the researcher found that some participants were more vocal than others. Often, the conversation was dominated by one or two participants. Most participants did provide responses to questions during the focus group; however, not all participants provided feedback to all questions. In addition, the conversation during focus groups sometimes veered off topic more so than in the interviews. As a result, future one-on-one interviews are recommended to collect qualitative data from teacher participants. In each one-on-one interview, the participants appeared to speak with ease when responding to the questions. They also provided information similar to the responses during the focus groups. Another benefit seen for using one-on-one interviews is that in a focus group, one participant may influence the tone and perspective of the conversation when in a group.

The focus group protocol is located in Appendix E. For future research, some of the questions could be reworded to better focus the point of the questions. Question 6 asked the participants to describe the first time they worked with the math coach. During the focus groups and one-on-one interviews, some participants did not remember the first interaction because of the length of time the coach had been utilized at the school. In light of the study's focus being on the interactions with the math coach, a better question

to ask might be, “Describe a typical interaction you have had with the math coach.” With this question, the participant is describing an interaction with the coach that best portrays topics of discussion and outcomes of the interaction. Question 7 could also be reworded; rather than asking what positive changes participants have made to their math instruction, asking participants to explain what strategies or methods the math coach has shared with them that they have incorporated into their instruction. A follow-up to the question could ask the participants what benefits have they experienced as a result of incorporating these strategies. When conducting the focus groups and interviews, some participants indicated that they had not had a positive impact as a result of working with the coach; however, they later were able to identify examples of positive impact. By changing the wording of the question, participants might be less likely to contradict themselves with their responses.

Question 8 asks about negative impacts the participants have experienced as a result of working with the math coach. A better question to ask might be, “What disadvantages have you experienced by having a math coach at your school?” Careful consideration should be given to what information the researcher is seeking to determine whether to maintain the original questions from the protocol or use the suggested changes to the protocol.

The recommendations outlined here are lengthening the study period, adding reflection logs for participating teachers, including more math curriculum coaches from a variety of schools, utilizing one-on-one interviews alone rather than in combination with focus groups, and rewording some of the questions from the interview protocol. These changes have the potential to provide results that could be generalized across a broader spectrum.

Implications

Methodological implications. Creswell and Plano Clark (2011), Plano Clark and Ivankova (2016), and Creswell (2014) expressed the belief that a mixed-methods study provides a more complete understanding of a situation than would be provided by a study using one method alone. This study provides a lens into the impact of the role of a math curriculum coach. Applying this lens to future studies of the mathematics coach's role could provide further understanding of the role of the mathematics coach in terms of the duties and the responsibilities. The mixed-methods approach could also provide an opportunity for deeper understanding of the consistency of interactions as well as the purpose for these interactions.

A more complete picture of the impact of the coach on teacher instructional practices could result from including student achievement data in a mixed-methods approach. If the data collection is changed to include teacher reflection logs, the data could demonstrate what teachers do differently with their instruction. With these modifications, the potential for measuring changes to student achievement could be tracked. Using student achievement data would also necessitate extending the study period to include multiple years. By doing so, student achievement data could be tracked as a pool of students. Also, student achievement data could be tracked by teacher. Attention would need to be given to determine how the changes to student achievement relates to the work of the math coach with classroom teachers.

Because the research questions sought to determine the impact of the role of the math coach and teacher perceptions of its impact, a strictly quantitative study might be hard to achieve. A survey that asks teachers to rate the impact and interactions could be used; however, as Creswell and Plano Clark (2011), Creswell (2014), and Plano Clark

and Ivankova (2016) indicated, the mixed-methods approach builds a more complete picture than quantitative or qualitative alone can. By incorporating the qualitative pieces of reflection logs, focus groups, and interviews, the participants are better able to express their understanding of the questions being asked and are better able to paint a picture of complexities of the working roles of each party in the interaction.

Practical implications. Throughout the focus groups and one-on-one interviews, participants expressed concern that they were unclear as to the duties and responsibilities of the math coach or general curriculum coach. One participant made a suggestion for addressing this particular concern:

> Again that goes back to people specifically outline what their job is. And maybe even at the very beginning of the school year. You know principals have that beginning of the school year meeting and they will say, "This is our social worker, and this is what a social worker does. And this is our guidance counselor" because in my 17 years I'll bet there are teachers that haven't been there as long. They still don't know what a social worker does or what the goals of the guidance counselor are.

This participant went on to explain that the social worker and guidance counselor are important staff members. She expressed the notion that if staff do not know what these roles do, how will they know the role of the math coach? Her suggestion implied that a brief description of the role during a staff meeting would be very useful in addressing the lack of clarity. A further suggestion would be to have a brief synopsis of the role of math coach in the faculty handbook that teachers can refer back to for future reference. By providing these two instances of explanation, teachers could have a better understanding of the role of the coach and utilize the role more effectively.

The themes discovered from the feedback from teacher participants yield some recommendations for practice within their school or district settings. During the focus groups and interviews, teachers routinely expressed concerns that they were unclear what the specific duties and responsibilities of the math coach were. To correct this concern, administrators need to provide teachers with clearly defined descriptions of their expectations for the math coach within their building. Providing the math coach's schedule with teachers could also be useful in helping teachers know when she is available to them for assistance. Various participants felt that the coach should be working with small groups of students; however, they also believed that the coach was doing more administrative work than coaching. Other participants expressed concerns that the coaches were responsible for too many things which resulted in them being taken away from their ability to work directly with teachers and instructional strategies. In such cases, it is recommended that careful consideration be given to the duties of the math coach while determining clear goals for the work of the coach.

In the setting where a general curriculum coach was utilized, participants expressed concern that the coach focused more on English language arts than on mathematics. Participants indicated this difference in focus groups five times while stating that the general curriculum coach had no impact on their mathematics instruction. This concern implies that having a general curriculum coach covering all grade levels in the school is a lofty assignment and may lead to mathematics being devalued compared to English language arts. Van de Walle and Lovin (2006) and Marsh and Willis (2007) are just a few of the experts calling for students to gain conceptual understanding in math. Teachers were educated as students and often trained in their preparation courses to apply strategies as taught through direct instruction. If the shift to conceptual understanding is

to be successful, teachers need support from school personnel. Using School B as an example, a general curriculum coach has difficulty addressing mathematics due to a focus on literacy and the many other responsibilities assigned to them. In order to determine the benefits of subject specific coaches, further research is necessary.

Conclusion

The role of math coach has the potential of having a positive impact on teacher instructional practices. The impact of the role of math coach on teacher self-efficacy remains unclear. Participants at School A where the math coach was used had a slightly higher sense of self-efficacy on the presurvey, while the postsurvey results were nearly the same at both schools. Participants in this study were able to identify changes made in their instruction based on work with the math coach. These changes were viewed as positive changes; however, further research is needed to determine the extent of the impact of the role of the mathematics coach and whether it is cost effective. The focus of the research should be expanded to include more schools, coaches, and teachers; and the time frame of the study should be extended. This study, along with future studies, has the potential to add valuable insight to the current body of knowledge on this subject.

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Appendix A

Informed Consent Agreement

Informed Consent Agreement

For this study, Alison Syverson, the researcher, a doctoral candidate at Gardner-Webb University seeks to explore the following questions:

1. What is the impact of the use of a math curriculum coach on teacher instructional practices in the area of math?
2. What is the impact of the use of a math curriculum coach on teacher perceptions of their instructional practice?
3. What is the impact of the use of a math curriculum coach on teacher sense of self-efficacy?

As a result of this study, the researcher seeks to provide findings that will add to the body of research used to develop the role and expectations of mathematics curriculum coach as well its effectiveness. Having participated in this study, you may develop a better understanding of the role and expectations of the mathematics curriculum coach with whom you work.

By signing below, you are giving consent to participate in this research study in one or more ways. This study requests participation from a mathematics (general) curriculum coach by responding to journal reflection prompts. Classroom teacher participation includes a survey of 21 statements that will be administered at the beginning and end of this four to 6 weeks study, focus groups including six to eight randomly selected teachers, and/or one-on-one interviews of four to five randomly selected teachers.

As all responses will be anonymous, identifiable only by a code such as teacher 1, no risk is involved in participating in this study. All responses will be maintained at the home of the researcher in a locked cabinet and secure file until the end of the research

study. Upon the completion of the study, all responses and transcripts will be destroyed. As a means to insure the confidentiality of responses, a proxy will administer the surveys and conduct the focus groups and interviews.

At any time during this study, a participant may withdraw without penalty by contacting the researcher. Should you have any questions regarding this study and your participation therein, please contact, Alison Syverson at xxxxxxxxxx.

By signing this agreement, I am providing my consent to the aforementioned researcher to participate in this study of the impact of math curriculum coaches. I am agreeing to participate through journal reflection responses, surveys, focus groups, and/or one-on-one interviews. I also am acknowledging that I understand my role and that I may withdraw from participation at any time.

______________________________ ______________

Signature of Participant **Date**

______________________________ ______________

Print Name of Participant **Role (Coach/Teacher)**

Appendix B

Permission to use Mathematics Teaching Efficacy Beliefs Instrument

Alison Syverson XXXXXXXX
To: huinker@uwm.edu
Mar 31 at 3:12 PM
Greetings Dr. Huinker,

I am currently a doctoral student at Gardner-Webb University pursuing a Doctorate of Education in Curriculum and Instruction. My area of interest is in mathematics education. As a result I am proposing to study the impact of mathematics curriculum coaches on teacher instructional practice and teacher self-efficacy.

During my reading I found studies that utilized the Mathematics Teacher Efficacy Beliefs Instrument on which you worked with Dr. Larry Enochs. I believe this instrument would yield pertinent information to my study. In light of this belief I would like to be granted permission to use this instrument in its entirety or with minor rewording as deemed necessary. I do feel the instrument can be used as is pending approval from my dissertation chair. Would you be willing to grant me permission to use this instrument in my research? In searching you out, I discovered that Dr. Enochs had passed away and I am unable to locate Dr. Phillips. Therefore, I am reaching out to you.

Should you have any questions regarding my work prior to approving my request, I can be reached via email (XXXXXXXXXX) or by phone at XXXXX (between 10am and 9pm EST). Thank you so much for your consideration.

Kindest regards,
Alison Syverson

DeAnn M Huinker
To: Alison Syverson
Apr 4 at 9:17 AM
Alison,

You have permission to use the MTEBI.

Best to you in your research,
DeAnn Huinker
Professor, Department of Curriculum and Instruction
Director, Center for Mathematics and Science Education Research (CMSER)
University of Wisconsin-Milwaukee
XXXXXXXXXXX

Alison Syverson
Thank you so much!

Appendix C

Mathematics Teaching Efficacy Beliefs Instrument and Scoring Guide

Mathematics Teaching Efficacy Belief Instrument (MTEBI)

Inservice Teachers

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

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

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

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

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

Appendix C

Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) Scoring Instructions

Step 1. Item Scoring: Items must be scored as follows: Strongly Agree = 5; Agree = 4; Uncertain = 3; Disagree = 2; and Strongly Disagree = 1.

Step 2. The following items must be reversed scored in order to produce consistent values between positively and negatively worded items. Reversing these items will produce high scores for those high and low scores for those low in efficacy and outcome expectancy beliefs.

Item 3	Item 17
Item 6	Item 18
Item 8	Item 19
Item 15	Item 21

In SPSSx, this reverse scoring can be accomplished by using the recode command. For example, recode ITEM3 with the following command:

RECODE ITEM3 (5=1) (4=2) (2=4) (1=5)

Step 3. Items for the two scales are scattered randomly throughout the MTEBI. The items designed to measure Personal Mathematics Teaching Efficacy Belief (SE) are as follows:

Item 2	Item 11	Item 18
Item 3	Item 15	Item 19
Item 5	Item 16	Item 20
Item 6	Item 17	Item 21
	Item 8	

Items designed to measure Outcome Expectancy (OE) are as follows:

Item 1	Item 9	Item 13
Item 4	Item 10	Item 14
Item 7	Item 12	

Note: In the computer program, DO NOT sum scale scores before the RECODE procedures have been completed. In SPSSx, this summation may be accomplished by the following COMPUTE command:

COMPUTE SESCALE = ITEM2 + ITEM3 + ITEM5 + ITEM6 + ITEM8 + ITEM11 + ITEM15 + ITEM16 + ITEM17 + ITEM18 + ITEM19 + ITEM20 + ITEM21

COMPUTE OESCALE = ITEM1 + ITEM4 + ITEM7 + ITEM9 + ITEM10 + ITEM12 + ITEM13 + ITEM14

Appendix D

Curriculum Coach Log Forms

Curriculum Coach Log - Initial Information

The purpose of this first entry is to gather some general information regarding your role and experience as a math coach/curriculum coach. Your participation in this research study is greatly appreciated. Candid answers to all questions or prompts in these coach logs entries is very important to this study and potential recommendations.

What degree(s) do you hold? Please list all degrees you have earned, related subject areas, and grade levels, if it applies to your degree.

How many years have you been in education?

0-5 years
6-10 years
11-15 years
16-20 years
21-25 years
26-30 years
30+ years

How long have you been a curriculum coach?

Describe your role and the responsibilities you have as curriculum coach. Please be as specific as possible.

Curriculum Coach Log - Week 1-Week 4

For this log entry you will asked to respond to prompts relating to your interactions with teachers and students during the previous week. You will also be asked to reflect upon the potential success of these interactions as well as possible next steps. The term, interactions, refers to any discussions, planning, etc. with teachers related to instructional practice and pedagogy.

Describe the types of interactions you had with teachers during the previous week.

What recommendations or suggestions were you able to make related to instructional practice teaching math?

What concerns regarding math instruction do you have based on your interactions with these teachers?

Looking forward what steps do you plan to take with these teachers?

Curriculum Coach Log - Reflection

Over the last four weeks you have had many interactions with teachers. Please reflect upon these interactions and provide your thoughts regarding the quality of the experiences, impact upon the teachers' instructional practice, and steps you would like to take in the future.

Please describe how receptive you perceive the teachers to be of your work with them on instructional practices in math.

Explain the impact you feel your work with the teachers had on their instructional practice in math. Please include examples of implementation by teachers in their classrooms, on assessments, or in planning.

Moving forward, what steps would you like to take in the future as you work with the teachers to improve or enhance their instructional practice?

Appendix E

Focus Group and Interview Protocol and Questions

Focus Group and Interview Protocol and Questions

Focus Group Protocol Script

Thank you so much for coming today. You were asked to participate in this focus group because you each teach at a school with a math curriculum coach. I want to tap into your experiences and interactions with the math curriculum coach (curriculum coach). Please answer the questions open and honestly as the responses will not be shared in a way to identify the responder. I would like the focus group to take the shape of a conversation.

1. Tell me your name and how long you have been teaching.
2. What do you enjoy most about teaching?
3. Share your thoughts about teaching math.
4. What is the first thing that comes to mind when you hear “math curriculum coach” (curriculum coach)?
5. What are the duties and responsibilities of the math coach (curriculum coach)?
6. Tell me about the first time you worked with the math coach (curriculum coach).
7. What positive changes to your instructional practice have you made as a result of working with the math coach (curriculum coach)?
8. What negative impact has working with the math coach (curriculum coach) had on your instructional practice?
9. What has helped you grow in your teaching of mathematics?
10. How has the math coach (curriculum coach) helped change your experience with math?
11. Describe the support you feel is needed from the math coach (curriculum coach) to help you be successful teaching math.

12. If you could give advice to decision-makers regarding the use of a math curriculum coach (curriculum coach), what advice would you give?
13. What would you like me to know about a math curriculum coach that was not addressed by the previous questions?

Introduction for one-on-one interviews

Thank you so much for coming today. You were asked to participate in this interview because you teach at a school with a math curriculum coach. I want to tap into your experiences and interactions with the math curriculum coach (curriculum coach). Please answer the questions open and honestly as the responses will not be shared in a way to identify you. I would like the interview to take the shape of a conversation.