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## A Mixed-Methods Examination of Inservice Elementary School Teachers' Mathematics Mentoring Experiences in a Mathematics Master's Degree Program

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## ACCEPTANCE

This dissertation, A MIXED-METHODS EXAMINATION OF INSERVICE ELEMENTARY SCHOOL TEACHERS' MATHEMATICS MENTORING EXPERIENCES IN A MATHEMATICS MASTER'S DEGREE PROGRAM, by HARDRAY J. DUMAS, was prepared under the direction of the candidates Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the Doctor of Philosophy in the College of Education, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chair, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty. The Dean of the College of Education concurs.

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#### PROFESSIONAL ORGANIZATIONS

National Council of Teachers of Mathematics  
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## ABSTRACT

### A MIXED-METHODS EXAMINATION OF INSERVICE ELEMENTARY SCHOOL TEACHERS' MATHEMATICS MENTORING EXPERIENCES IN A MATHEMATICS MASTER'S DEGREE PROGRAM

by  
Hardray J. Dumas

Elementary school teachers teach a variety of subjects requiring a range of content and pedagogical knowledge, and substantial professional development to support this knowledge often is lacking (Clements & Sarama, 2008). Mentoring, an important aspect of professional development, is particularly useful for developing content and pedagogical knowledge. However, content mentoring, i.e., mentoring support in a specific content area such as mathematics, has received little attention in research on elementary teachers. To address this gap in the research, this study examines support in a master's program that provides mentoring specifically in mathematics for elementary school teachers. Using a sequential explanatory design, this mixed methods study employs the Mentoring for Effective Mathematics Teaching (MEMT) survey with twenty-six (26) graduates of the program. The 34-item Likert scale survey reveals perceptions of their mathematics mentoring experience. In order to obtain a deeper understanding of the perceptions, four (4) of the teachers participated in semi-structured interviews. This last data source provides additional insights into the role of school context in mentoring. The results reveal qualities of mentors that inservice elementary mathematics teachers found to be important beyond mathematics content knowledge, specifically, differences in school contexts that impact elementary mathematics teachers' mentoring experiences. The results suggest direction for future research on mentoring for elementary school teachers who teach mathematics.

A MIXED-METHODS EXAMINATION OF INSERVICE ELEMENTARY SCHOOL  
TEACHERS' MATHEMATICS MENTORING EXPERIENCES IN A  
MATHEMATICS MASTER'S DEGREE PROGRAM

by  
Hardray J. Dumas

A Dissertation

Presented in Partial Fulfillment of Requirements for the  
Degree of  
Doctor of Philosophy  
in  
Early Childhood Education  
in  
the Department of Early Childhood Education  
in  
the College of Education  
Georgia State University

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## TABLE OF CONTENTS

	Page
List of Tables .....	v
List of Figures .....	vi
Abbreviations .....	vii
 Chapter	
1	SUPPORTING ELEMENTARY SCHOOL MATHEMATICS TEACHERS THROUGH MENTORING: AN EXAMINATION OF LITERATURE .....1
	Introduction.....1
	The Literature Review Process and Emerging Conceptual Framework.....3
	Purpose of Review .....6
	Research on Mentoring.....6
	Summary and Conclusions .....24
	Final Thoughts .....27
	References.....28
2	A MIXED-METHODS EXAMINATION OF INSERVICE ELEMENTARY SCHOOL TEACHERS' MATHEMATICS MENTORING EXPERIENCES IN A MATHEMATICS DEGREE PROGRAM .....35
	Introduction.....35
	Purpose of Study.....37
	Related Literature.....38
	Research Questions.....48
	Methods.....49
	Results.....55
	Discussion.....68
	Conclusion .....73

Limitations .....	74
References .....	76
Appendixes .....	82

## LIST OF TABLES

Table	Page
1 Research Questions and Data Sources Table.....	54
2 Five factors for Mentoring for Effective Mathematics Teaching .....	55
3 “Personal Attributes” for Mentoring for Effective Mathematics Teaching.....	56
4 “System requirements” for Mentoring for Effective Mathematics Teaching.....	56
5 “Pedagogical knowledge” for Mentoring for Effective Mathematics Teaching ...	57
6 “Modeling” for Mentoring for Effective Mathematics Teaching .....	58
7 “Feedback” for Mentoring for Effective Mathematics Teaching .....	58
8 Analysis of Themes using research questions .....	60

## LIST OF FIGURES

Figure	Page
1 Conceptual framework of research on mentoring.....	5

## ABBREVIATIONS

CCGPS	Common Core Georgia Performance Standards
MEMT	Mentoring for Effective Mathematics Teaching
MEPST	Mentoring for Effective Primary Science Teaching
NCTM	National Council of Teachers of Mathematics

CHAPTER 1  
SUPPORTING ELEMENTARY SCHOOL MATHEMATICS TEACHERS THROUGH  
MENTORING: AN EXAMINATION OF LITERATURE

**Introduction**

Skovsmose and Yasukawa (2009) recognize the importance of mathematics and its relationship to the real world. They argue that the relationship between mathematics as a school subject, a discipline, and as a part of people's lives has to be addressed and analyzed. Competent mathematics teachers can accomplish this in classrooms. However, a lack of mathematics support, mathematics phobias, mathematics anxiety, and lack of understanding of the content may prevent elementary school mathematics teachers making these important connections with their students (Brady & Bowd, 2005; Humphrey & Hourcade, 2010). Being able to understand how mathematics is a “universal language” and how different nations and cultures thrive by using mathematics for their everyday lives is important (Skovsmose & Yasukawa, 2009). Ultimately, with proper understanding of the structures of mathematics and its importance to the world, children gain a sense of *mathematical power*. As discussed in Bishop (2010) this power not only provides individuals with the ability to explore, conjecture, and reason logically, but it also helps to develop a sense of personal self-confidence (NCTM, 1989). Assuring that we have elementary teachers who are highly prepared to teach mathematics and supporting those teachers in their critical induction years is of vital importance. One specific practice for supporting elementary school mathematics teachers that influences the creation of a mathematically literate nation is mentoring.

Over the past four decades mentoring of educators has been broadly researched. Scholars in the field of teacher development, such as Feiman-Nemser (2001), Ingersoll (2003), Strong (2009), and others, have all added to the professional literature citing the need for enhanced teacher development and support in the form of mentoring. A primary reason for this is the high rate of attrition amongst novice teachers. Teachers are graduating and entering the profession, but as a result of factors such as lack of professional development opportunities, inadequate administration support, unequal access to resources, and lack of classroom autonomy, novice teachers frequently do not remain in the teaching profession (Ingersoll & May, 2011; Ingersoll & Perda, 2010).

Another reason supporting the need for enhanced teacher development and support includes the implications for and influence on student achievement. Rockoff (2008) found that student achievement in mathematics and reading was higher for teachers who received more hours of mentoring than those who received fewer hours. Last, as revealed in Ingersoll and Smith (2004), teachers in high poverty schools are less likely to report participating in mentoring and induction than those in low poverty schools. This finding illuminates the differences in teacher support across different demographics.

In addition to differences in contexts, elementary teachers also have the daunting task of teaching multiples contents, not only mathematics, but science, social studies, and language arts. These teachers rarely receive mentoring for each specific content area, particularly in mathematics, an area that is highly tested. Teachers may attend workshops and have occasional professional development sessions, but elementary school teachers rarely receive ongoing training and support in mathematics (Birman et al., 2007).

In the *Principles and Standards for School Mathematics* (National Council of Teachers of Mathematics, 2000) NCTM provided standards for the nation's mathematics teachers in order to best educate all children. The Teaching Principle states "Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well" (p. 17). In this era of reform mathematics, teachers are encouraged to follow this principle; however, not all mathematics teachers are prepared and/ or supported in ways that make living by this principle possible. A second principle, the Equity Principle, encourages mathematics teachers to have high expectations and effective methods to support the learning of all students in mathematics. These principles have the potential to influence the mathematics learning opportunities that children experience, but implementation of these principles requires that teachers become highly effective teachers; a position not easily arrived at without support.

### **The Literature Review Process and Emerging Conceptual Framework**

In this section I will describe (a) how the search of the literature was conducted, (b) how the studies on mentoring were chosen from those that were identified in the search, and (c) the categories that emerged into the Conceptual Framework for this study.

**The literature review.** I began the review searching for research on mentoring *in general*. Using the ERIC database broad terms and phrases such as mentors, mentoring, mentoring teachers were used. Other reviews of the literature were also used to identify additional studies about mentoring. Next, in order to identify studies specific to the content of mathematics phrases such as mentoring mathematics teachers and mathematics teacher mentors were used. Lastly, literature on mentoring as related to school context

was searched using terms and phrases such as school context mentoring, mentors urban schools were used.

**How studies were chosen.** From the studies that were produced by the searches I selected primarily empirical studies related to mentoring; however, some theoretical pieces were included. In order to be included in the final review reported in this paper studies were chosen that strongly support the topic and focus on mentoring elementary school teachers. Preference was given to studies on inservice elementary school teachers, but in some instances studies on preservice teachers that were strong in content or methodology were included. Studies that did not provide insights into mentoring or studies that did not focus on elementary were omitted from this review.

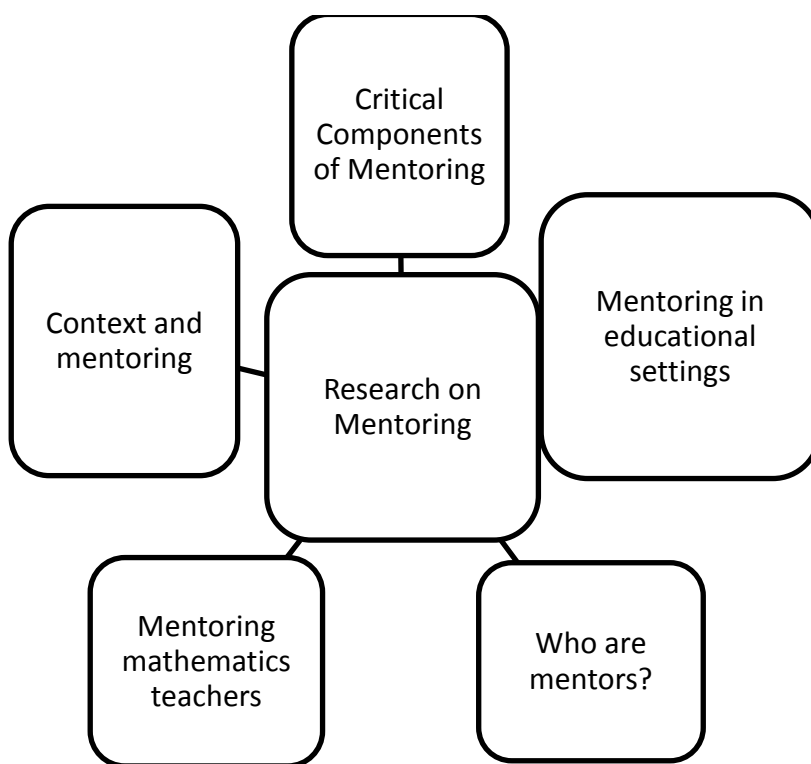
**The conceptual framework.** From the studies that were selected five strands emerged as significant with respect to mentoring (See Figure 1) and compose my conceptual framework. The first strand included studies which looked at or identified the *critical components of mentoring*. This strand provides a general definition of mentoring as well as describes the different components that have been found through the literature to be important for effective mentoring.

A second strand of studies looked at *mentoring in educational settings*. These studies looked at models and forms used for mentoring educators. Some mentoring programs used specific models and forms, while others used components of different models and forms to create a mentoring program that worked for their situation.

The third strand of studies tended to be more descriptive and looked at *who mentors are*. These studies described groups of people act as mentors, including a traditional view of mentoring as well as a more contemporary view.

The fourth strand were studies done on *mentoring in different content areas*. Due to the focus of this current study, mentoring specifically related to mathematics was targeted and included literature related to mentoring elementary school mathematics teachers.

Lastly, a much smaller category on *the context* in which mentoring occurred emerged. Literature was found to suggest that school context may influence the effectiveness of mentoring. Due to the researcher's interest in the urban school context, literature was included that focuses on mentoring teachers in urban school contexts.



*Figure 1.*  
Conceptual framework of research on mentoring.

### **Purpose of Review**

The purpose of this review of the literature is to explore the research conducted to date in the field of mentoring elementary school mathematics teachers and the effect that school context has on mentoring. The next section provides a review of current literature on each of the five categories that emerged as my conceptual framework on mentoring.

### **Research on Mentoring**

In this section significant studies from each component of the conceptual framework will be reviewed. It is divided into the following sections:

- Critical components of mentoring
- Models of mentoring in educational settings
- Who mentors are
- Mentoring elementary mathematics teachers
- Context and mentoring

### **Critical Components of Mentoring**

In the literature, researchers identify several critical components of mentoring. In a four-year study of eight mentors, Gardner (2009) found that mentoring actually requires a specialized and unique body of knowledge that not every teacher has. He developed a model in which he identified two critical components: a *product framework* and a *process framework*. In the product framework, mentees work as an apprentice to their mentors; the process framework requires mentees to inquire and reflect upon their practices. Using both, novice teachers are able to build both the conceptual and practical

aspects of their practice, thereby creating a superior basis for mentoring which ultimately creates the best support for teachers. This research is useful for characterizing mentoring as a process; however, more specific components and actions of mentoring were not identified. Other researchers have explored the processes of mentoring.

One key process identified by both Onchwari & Keengwe (2008) and Hudson (2007) is *relationship and rapport*. In Onchwari & Keengwe's study of 44 Head Start teachers across two states, data was collected via interviews and classroom observations on teachers from an early literacy mentor-coach program. Findings from this study indicate teachers' need for more personal relationships with their mentees. Within the literature, high significance is placed on mentoring beginning with a foundation of a strong personal and professional relationship. Mentors have to help their mentee become comfortable with him or her in order for information, problems, and/or fears to be shared. A comfortable relationship also works to enhance and promote a mentee's change of attitude toward a change in teaching practice (Ambrosetti & Dekkers, 2010). The mentor is then able to learn the mentee's needs and support the mentee toward achieving his or her goals.

The *nature of relationships* is another key component identified by Barth (2006). In his conceptual piece he discusses four types of relationships that are often seen amongst educators in schools. One relationship is parallel play where teachers within a school work in isolation from each other. In this relationship teachers coexist in the same school, but they work alone, not sharing information, ideas, resources, etc. Another relationship that exists in schools is adversarial relationships. This relationship is characterized by teachers and/or administrators acting negatively toward one another,

withholding valuable information, or even competing against one another. The third type Barth identifies is congenial relationships. This relationship exists between teachers and administrators in a school and is positive, interactive, personal, and friendly. The final and most challenging relationship to achieve in schools is collegial relationships. This relationship is characterized by factors that work together to grow a professional learning community.

Barth (2006) claims that collegial relationships are the type most conducive to productive mentee/mentor work. In order for collegial relationships to be achieved, Barth recommends four activities that educators should engage in: they should talk with each other about their practice; they should share knowledge in order to improve each other's practice; they should observe each other in action; and lastly, they should root for each other's success by being supportive. While Barth's work is not empirical, it is important for identifying critical types of relationships novice teachers need in their new profession.

Also key is *the role* mentors takes as they work with their mentees. Ngara and Ngwarai (2012) used a Likert-scale survey with 15 pairs of student teachers and their mentors in order to determine mentor and mentee perceptions of the roles and responsibilities for mentors. They identified several different critical roles of the mentors who work with beginning teachers. One role is as counselor, someone who can help the mentee make sense of the professional world around them. A second role is a guider who helps lead the mentee in the right direction. Yet another is a networker who can direct the mentee in the direction of resources by assisting them to become acclimated to specific people and groups within the teaching profession. The participants in this study also identified other important roles of mentors, such as viewing them as a role model

and a constant giver of feedback. These roles help the mentee have a model to follow, and they help the mentee become aware of areas of achievement, as well as areas where improvement is needed within their practice.

Another key component in mentoring is the need for mentors to have *good interpersonal skills* when working to establish a relationship with a mentee (Rowley, 1999; Hawkey, 1997). Ngara and Ngwarai (2012) also found that the mentees needed the mentors to be approachable, open, effective communicators, good listeners, flexible, and knowledgeable of the teaching profession. These interpersonal skills make an impact on communication and the manner in which mentors respond to the needs of mentees.

Ngara and Ngwarai (2012) also point out that mentors provide *critical supports* that novice teachers need. These supports include nurturing self-empowerment and reassurance, which helps the mentees know they are capable of being successful at their job. They also need to act as advocates for the novice teacher, collaborators with the novice teacher, problem solvers with the novice teacher, and strategists with the novice teacher. All these roles help the novice teacher to become reflective, critical, and confident within their practice, processes and products necessary to become an effective teacher. Interestingly, this piece of research provides several different pieces of information indicating the different roles and support that mentors offer. While the survey provided useful information, the lack of additional data sources limits the credibility of this work.

Finally, in considering the different roles that are necessary in mentoring, it is also key that mentors *understand the distinctive characteristics of the adults* they will be mentoring. Learning in adulthood has characteristics that mentors should be aware of in

order to make an impact on the learning of their mentees. In a book by Knowles, Holton, and Swanson (2005) adult learners are unique learners who (1) need to know why they are learning what they are learning; (2) they are self-directed in their learning; (3) they have formal and informal life experiences that impact their learning; (4) they have a readiness to learn when forced to cope or deal with situations in life; (5) they require that the learning they participate in relate to their life and has relevance; (6) and lastly, adults are internally motivated when they are ready to learn. By understanding these characteristics, mentors are more effective at forming relationships and promoting mentees to learn and reflect.

**Summary.** In the literature researchers discussed key components that are critical for mentoring. Components that were consistently reported include *building relationships* and *appropriate interpersonal skills* of mentors. Additionally, mentors must assume *different roles*, such as a counselor and a networker, and provide *different types and levels of support* as they work with mentees. The theoretical work reported in this review supports the empirical studies in this regard and serves to provide a framework of the perspectives of teachers with regard to the effective components of mentoring. However, the literature on mentoring does not thoroughly examine the content-specific needs which elementary teachers experience. Additional studies exploring those needs are necessary.

### **Forms of Mentoring in Educational Settings**

Over time researchers have developed several different models of mentoring. Feiman-Nemser (2012) identified models with varying levels of support that mentors provide in the induction of novice teachers. In one model the mentor's role is limited due to the demands of teaching that prevent the mentor from having as much time as needed

to be involved. In this model, when the mentee needs help, the mentor assists. Because of this limited interaction, there are questions of whether the process is actually beneficial. In another form, the mentor's role is more involved. This model is strategic and intentional and is based on the developmental needs of the novice teacher. In this induction model mentoring is based on important features that are cited in the literature (Glazerman et al. 2008; & Smith and Ingersoll, 2004), including matches between the mentor and mentee, advanced and ongoing training of mentors, and even physical proximity. Models that are based on these characteristics are known to have more impact on teachers and students (Glazerman et al. 2008; & Smith and Ingersoll, 2004).

Ngara and Ngwarai, (2012) identified three models of mentoring programs in schools. The first is the apprenticeship model where a mentee works alongside their mentor and emulates the mentor. The mentee's practices and experiences are under guidance and supervised. The second is the competency model where learning occurs based on pre-defined competencies that the novice teacher is expected to master. Lastly, the reflective mentoring involves support from a mentor that is coupled with ongoing reflection for the purpose of identifying flaws, weaknesses, strengths, and successes. They point out that one form alone may not meet the needs of a mentoring program; aspects from each may be necessary for effective mentoring.

Coaching is also a dominant model for mentoring in schools. Coaching is based on the premise of helping beginning teachers improve their effectiveness by providing them with feedback on their practices to promote self-reflection and self-analysis (Veenman, de Laat, & Staring, 1998). Cognitive coaching, developed by Costa and Garmston (1994), is guided by the principle that teachers' behaviors can be influenced

once their thought processes have been addressed. The process of cognitive coaching involves a three-stage cycle. First, the coach (mentor) and the teacher have a pre-conference, where the beginning teacher discusses areas in their instructional practice for which they would like the mentor to focus and provide assistance. Second, the teacher has an observation where the coach (mentor) visits the mentee's classroom and observes, focusing on the areas discussed during the pre-conference. Finally, the mentee and mentor have a post-conference where the observation is reflected upon and discussed. This type of process promotes self-reflection by the teacher and has been found to be quite effective. Due to the specific focus of the intervention, the mentee is able to receive specialized attention and assistance rather than broad recommendations on practice.

Supervision is also considered a model for mentoring in the schools. Supervision as defined by Glickman (1990) is a function of schools that acts as glue, combining all the elements of instructional effectiveness. It is the process by which an individual (mentor) provides a link between the novice teacher's needs and organizational goals for the ultimate success of the school. In Glickman's book on supervision he acknowledged the mentoring that is examined also pulls aspects of supervision within its practice. Glickman describes three philosophies related to supervision listed in order of the amount of control the supervisor holds: directive, collaborative, and non-directive supervision. Directive supervision relates to the existence of standards and competencies that teachers need to be effective. This situation is characterized by high supervisor responsibility and low teacher responsibility. Collaborative supervision is based on problem solving between the supervisor and teacher. Here, the supervisor and the teacher have equal responsibility. And lastly, non-directive supervision places supervisors in the role of

promoting private learning experiences rather than guiding or asserting. With this philosophy the supervisor's responsibility is low, and the teacher's responsibility is high. Glickman asserts that supervision requires knowledge, interpersonal skills, and technical skills.

**Summary.** From the literature, we can identify several forms of mentoring, including forms that vary in their level and kind of support such as a coaching model versus a supervision model. They differ in the level of support mentors offer, in the actual process of assisting, and even in the method of observing. Unfortunately we are not able to discern from the literature between highly effective forms of mentoring and those that are less effective. The models are identified and described superficially and do not provide an understanding of exactly which processes of mentoring are more appropriate for teachers in certain disciplines, certain schools, and certain levels. Empirical work in this area is critically needed.

### **Who Mentors Are**

No single description of mentors exists in the literature, nor is there a single answer to who mentors are and what they typically *look* like. Historically, mentors were perceived as older, more experienced individuals, while mentees were younger, more inexperienced individuals. In that perspective, mentoring is an intentional, nurturing, instructive, and supportive activity by the older more experienced person that helps shape the growth and development of the younger, less experienced person (Onchwari & Keengwe, 2008). Recent literature (Higgins & Kram, 2001; Smith, 2007) suggests that this stereotype of *who mentors are* has changed over time, and the contemporary view of mentors is somewhat different. Mentors may be co-workers, peers, or someone of equal

status or age. Mentoring in this sense is a learning opportunity where an experienced colleague socializes the learner to the larger context of the profession.

Feiman-Nemser (2003) report that some programs use retired teachers as mentors, while others use teachers who have classrooms but are released for some or all of their duties. Still others also use full-time teachers, but do not release any responsibilities. This variation creates disparities in the mentor's effectiveness.

Differences also exist in the roles of a mentor and a supervisor, however, in preservice teacher education programs mentoring is often linked to supervision. Ambrosetti and Dekkers (2010) point out, that while a supervisor may be involved in the development of a preservice teacher, the assessing plays a role in effectiveness. A supervisor judges the preservice teachers' performance, thereby influencing the relationship that is formed. Ambrosetti and Dekkers maintain that the process of mentoring should be based more on collaboration and the development of the mentee through the building of rapport.

Cornell (2003) points out that cooperating teachers who work in field placements in teacher education programs perform a kind of mentoring. In his study of 66 teachers who completed Likert-scale surveys regarding the roles and relationships of supervising teacher mentors and student teacher mentees, he found that the mentoring in the program he studied was more involved than the traditional view of mentors in field placements because the mentor teacher worked alongside and collaboratively with the preservice teacher as opposed to the passive learning often found in other field placements. This finding suggests an important venue to enhance preservice teacher preparation in that

intentional mentoring by practicing teachers during field placement could be a rich, often missed, opportunity.

**Summary.** The existing literature on mentoring does not provide a single definition of *who mentors are*. A more traditional view of mentoring based on age and experience has been cited in the literature and recognized by several researchers. However, recent research suggests a more contemporary view of mentoring now exists in the schools where they may use co-workers, peers, or someone of equal status or age. Additionally in preservice programs, supervisors and cooperating teachers may act as mentors. Empirical studies comparing the effectiveness of mentors in various roles are missing. We need to know if individuals in some roles are better mentors than others. Are different roles needed in different contexts? There is much to learn about who should be mentors.

**Training mentors.** An important aspect of who mentors are is the training of those who will be mentoring. Feiman-Nemser (2001) suggests that beginning teachers deserve caring and competent mentors, and this begins with a careful process of selecting, preparing, and supporting mentors in their ongoing work in mentoring. However, in their study of 16 mentors who participated in different mentoring programs, Gagen & Bowie (2005) found that very few programs provide organized training for mentors. As used in a successfully field-tested mentor training program, they suggested that before mentors begin working with teachers, it is vital that they receive professional development that emphasizes context and builds knowledge on the aspects of mentoring. Mentor training should also occur more than once; it should be ongoing and continue to support the mentor's practice and help him or her broaden a repertoire of mentoring

techniques (Gardiner, 2009). Viewing mentor training through the eyes of mentors is important research. This study differs from many others by providing the voices of mentors who had participated in different programs. Providing this contrast helps to illuminate what works and what does not in various mentor-training programs.

An example of one highly effective mentoring program was studied by Stanulis and Ames (2009). They studied an experienced teacher who participated in six days of professional development during the school year and an additional six hours of study groups each month on mentoring. The monthly training focused on being responsive (to the beginning teachers' needs) and challenging (of the mentees' thinking to consider new perspectives about teaching effectively). The mentor in this study had a myriad of resources to utilize in order to be an effective mentor. She was able to use the knowledge, experiences, and ideas from professional development to enact her work as a mentor. As a result, the mentor felt she was successful in her work with her mentees. This was evidenced in the comments and actions of the mentees, one who created a highly effective end-of-the-year action plan and one who expressed a new and improved vision of teaching.

Gagen & Bowie (2005) claim that systematic mentor training is one possible, yet critical solution to addressing differences in mentors. With mentor training, effective mentors support novice teachers, and the novice teacher will likely feel more prepared to remain in the profession compared to those who do not have effective mentors. In their study, Gagen and Bowie provided mentor training. However, a survey given after the initial training indicated that the mentors still felt unprepared to meet the needs of novice teachers. The researchers proposed subsequent mentor training over the school year that

covered topics of understanding the novice teacher and building the effective mentor. They concluded that ongoing training of this type is necessary to build and maintain quality mentors. While the researchers in this study were not as successful as they had hoped in their initial mentor-training program, the significance of long-term engagement with the mentor was realized. Further research in on-going mentor training is clearly needed.

**Summary.** In order to have effective mentors, a systematic preparation model is imperative. The traditional and the contemporary view of mentors can be applied to a variety of teacher support programs; however, understanding the best methods for preparing effective mentors in a variety of schools clearly needs further examination.

### **Mentoring Elementary Mathematics Teachers**

Research on the mentoring of *elementary* mathematics teaching is limited. Two studies were found, both of which focus on preservice teachers. Hudson (2007) used a survey, *Mentoring for Effective Mathematics Teaching* (MEMT), to determine areas of mentoring that were most essential to preservice mathematics teachers. The survey was adapted from one on science teaching, *Mentoring for Effective Primary Science Teaching*. The survey contains five factors associated with attributes/practices that are necessary for mathematics instruction. The five factors are as follows. (1) Personal Attributes. This includes the mentor's ability to be comfortable talking and listening and being supportive. Positive personal attributes build confidence within the mentee and encourage reflective practice. In the era of mathematics reform, reflecting on practice is of particular importance for teachers to promote student learning (NCTM, 2000). (2) System Requirements. This factor suggests that the mentor be able to accurately and

effectively communicate expectations of the school system to the mentee. (3) Pedagogical Knowledge. This is the ability to articulate how the mentor prepares for teaching. This includes planning, teaching strategies, classroom management, assessment, and content knowledge. (4) Modeling. This includes actions such as creating teacher-student relationships, using suitable and appropriate classroom language, effectively planning, effectively teaching, and managing time and resources. (5) Feedback. The mentor should provide written and oral feedback to the mentee. They should observe the mentee teach, review lesson plans, and provide expectations and advice (Hudson, 2007).

In Hudson's (2007) study, 147 preservice teachers completed the MEMT survey. He found that Modeling and Personal Attributes resulted in the highest mean scale scores, 4.01 and 3.96 respectively. Additionally, the factors System Requirements and Pedagogical Knowledge resulted in the lowest mean scale scores, 3.31 and 3.58 respectively. These results suggest which attributes mentoring programs should provide. Furthermore, as Hudson asserts, the results support the need for a set of standards for mentoring practices for mathematics.

The five factors in the model proposed by Hudson (2007) could be applied to different disciplines because they are characteristic of effective mentoring in general; however, there are items on the survey that are specific and important to mathematics teaching and learning. For example, in category #4 (modeling) the survey specifically asks about modeling mathematics teaching and demonstrating hands-on learning experiences. These are characteristics of reform-based mathematics instruction that are important. Pedagogical knowledge is yet another category that should be specific to

mathematics teaching. As Hill (2010) asserts, a deep and broad knowledge of mathematics is necessary for teachers to be effective in teaching mathematics. This type of knowledge is based on Shulman's (1986) pedagogical content knowledge, which is the specific knowledge and unique set of skills that teachers need to teach a subject effectively. Therefore, mentors exhibiting pedagogical knowledge specific to mathematics helps novice teachers gain an understanding of the unique knowledge that is necessary for teaching mathematics.

A second study, (Mewborn, 2005) proposes what mentoring in mathematics should look like in preservice teacher education based on five years of data from an elementary school mathematics methods course. As the instructor of a mathematics methods course, Mewborn collected data with surveys, field notes, written work, in addition to observing and interviewing 15 selected students. Similar to Feiman-Nemser (2001), Mewborn's preservice teachers participated in assisted performance, which allows prospective teachers to learn by engaging in tasks that they cannot do on their own without additional help. Mewborn developed three tasks. The first task involved critiquing an essay written by a teacher learning to listen to her student's words. This reading was followed by discussions with peers and written reflections about the reading. Concurrently, they engaged in a field experience with one third-grader with the goal of learning to listen and assess the child's mathematical thinking and planning subsequent instruction based on that thinking. During this experience the instructor provided feedback and coaching *in the moment* as the preservice teachers worked with their students. For example, the instructor might interject during the lesson and model what was being learned in the university classroom. Lastly, the preservice teachers had the

opportunity to observe and discuss a lesson taught by an experienced teacher in mathematics.

All of the types of activities described by Mewborn (2005) were useful as an alternative to traditional mentoring experiences. The instructor of the mathematics methods course proposed assignments that promoted discussion, reflection, and active involvement with young children as well as interactions with experienced teachers of mathematics. Mewborn used her role as the instructor in the course to collect pertinent research to inform how to best support the mathematics teaching of preservice elementary school teachers. While it was unclear the total number of participants for the case study, more of this type of research, using various sources of data, is needed to inform mentor programs. In addition the same type of research would be useful on *inservice* elementary school teachers.

**Summary.** The research in this section focused on mentoring preservice elementary school mathematics teachers. No research was identified that focused on the mentoring of practicing elementary school mathematics teachers. Other research exists on mentoring for middle and high school teachers, but is not relevant to this review. In order to better understand mentoring for inservice elementary mathematics teachers, additional research is clearly needed.

### **Context and mentoring**

There is a particular need for mentors in urban school contexts where new, inexperienced teachers are often placed. Though many studies cite the plight of working in urban schools, little research exists that examines how effective mentoring might be a strategy for addressing this dynamic.

Alkins, et al., (2006) assert that mentoring is vital for teachers in urban schools who are at risk of leaving the profession. They used case studies of six beginning teachers to identify what support teachers need to be effective in urban schools. Through focus groups, interviews, and surveys, they found that teachers in urban schools usually serve economically disadvantaged children, suffer from low morale, have limited resources, and experience differences in instruction implementation. Mentors who assist beginning teachers in these situations must also address the challenges of working in these environments themselves. Alkins, et. al. found that beginning teachers valued the support offered by informal mentors at their schools. They also indicated the need for support in understanding the role of race and culture and how they relate to teaching and learning. Additionally, the researchers found that beginning teachers valued the support offered due to the relationships between their universities and their current schools. Because of this dynamic, the beginning teachers felt more comfortable and familiar with their schools. This study adds to what is known about the challenges of working in urban schools and the specific type of support that would be necessary for those teachers.

McKinney, Berry III, and Jackson (2007) identified effective mentoring practices for preservice teachers in learning to teach mathematics in urban high-poverty schools. In their study 42 preservice elementary teachers provided written responses to interview questions to determine what supports are necessary for transitioning into teaching in urban schools. Their recommendations included preservice teachers having more experiences in urban school settings, being paired with highly qualified mathematics teachers, and understanding the dynamics of high poverty schools. The authors found that preservice teachers need field experiences and guidance by effective mentors to help

guide them to understand the school, students, and community in urban environments. With those supports their instructional practices will be better aligned with the students' actual lived experiences (Ladson-Billings, 1995). This study also adds to the body of knowledge regarding the support that elementary teachers need while working in urban schools. Not only does this study examine teachers in urban schools, but it specifically examines teachers of elementary mathematics. The same type of research exploring inservice teachers' needs in the same context would be useful.

Similar to McKinney, Berry III, and Jackson (2007), Perkins, Odell, McKinney, & Miller (2001) from the Urban Teaching Partnership Program (UTP) identified three key characteristics of preservice teacher preparation that were effective for working in urban schools. First, preservice teachers need field-based experiences that allow them to put theory and practice together to make sense of it. Next preservice teachers need specific experiences in urban school settings. This gives the preservice teachers an opportunity to face the challenges that are specific to urban schools and learn the knowledge, skills, and dispositions that are necessary to be successful. Finally there is a need for effective mentoring of preservice teachers. The UMP provides mentors to schools in urban settings which were identified as needing mentors.

Through interviews, observations, focus groups, and analysis of documents from UMP mentors (practicing teachers in the schools), Yendel-Hoppy, Jacobs, and Dana (2009) identified three challenges that emerged for the mentors. One challenge involved what mentors face as they help their mentee survive challenging circumstances while at the same time focusing on student learning and accepting responsibility for their own actions. This challenge is present because the mentor and mentee concurrently

experience the same challenges of survival and success. Mentor and mentee are both working to be effective educators, while the mentor is also working to support the mentee teacher's growth. A second challenge is developing a commitment to social justice by the mentee while navigating between survival and success. The last challenge involved the importance of working with school leadership to foster a learning environment within the school. This challenge consists of providing the resources needed for developing mentors who would promote a learning culture within the school. These challenges with the urban school context require that mentoring be a dynamic and ongoing process. For the survival of novice teachers, the placement, time and resources provided for mentors are crucial aspects of success.

In research focused on retention of African American teachers, Tillman (2005) makes the case for the school principal to act as an additional mentor to beginning teachers in urban schools. Though the research focused primarily on one group of teachers, Tillman insists that the following recommendations could apply to any beginning teacher in urban school contexts. (1) The principal should consult with the beginning teacher about their expectations for the mentoring arrangement, thereby understanding the competence of the teacher. (2) The principal should understand the experiences of the novice teacher in an effort to specifically tailor the mentoring experience. (3) The principal should reduce isolation by interacting with the novice teacher at specific blocks of time throughout the year. (4) Principals should be very strategic and thoughtful in their selection of primary mentors for the beginning teacher. This would take into account the mentor's mentoring and instructional capabilities. (5) Lastly, principals should understand the power dynamic between the novice teacher and

the principal. This would require the principal making the teacher at ease to discuss problems and seek help. All of these recommendations are methods of how principals can be involved in the mentoring process of novice teachers.

In a study using surveys and focus groups as data, Saffold (2006) points out that when mentors are provided for beginning teachers, there are benefits that the novice teachers believe to be a result of their mentoring experiences. Saffold used a case study to study teachers' perceptions of their mentoring experience in a teacher preparation program for teachers in urban schools. He found that one benefit of having mentors for novice teachers is having their self-confidence increased as a result of support and conversations with their mentor. Another benefit is having more confidence in their ability to teach children. Lastly, engaging in collegial relationships and networks supports their teaching. In addition, the researcher contends that in order for urban schools to support and influence the resilience of teachers, districts should select and train mentors who have certain understandings such as: understanding coaching techniques, knowledge of teacher standards, and an understanding of teacher development.

**Summary.** Research suggests that teaching in schools in diverse contexts presents different challenges. On the topic of context and mentoring, the majority of studies focused on the challenges of working in urban schools, including the challenges of working in that context and the specific mentoring needed to navigate such challenges.

### **Summary and Conclusions**

The main purpose of this review was to give an overview of the theory and research on mentoring elementary school mathematics teachers. In order to understand this concept mentoring was examined in relation to the following aspects:

**Critical components of mentoring.** Mentoring is seen as a conceptual and contextualized process (Gardiner, 2009). It involves building a foundation and relationship with rapport between a mentor and mentee. The relationship is vital and influences the effectiveness of the work that is carried out (Onchwari & Keengwe, 2008; Hudson, 2007). In order to cultivate the relationship and be effective, mentors must have good interpersonal skills (Rowley, 1999; Hawkey, 1997). Different types of relationships have been identified and characterized as important (Barth, 2006), for example, mentor as advocate, collaborator and problem solver have been identified as critical for novice teachers (Ngara and Ngwarai, 2012).

**Forms of mentoring in educational settings.** Different models and forms of mentoring teachers exist in the literature; as a result, mentoring looks different in different situations. Based on the level of support, forms range from very limited to more strategic and intentional (Ngara and Ngwarai, 2012, Feiman-Nemser, 2012). Other forms are based on the power of the mentor over the mentee, ranging from evaluative to coaching (Costa and Garmston, 1994; & Glickman, 1990).

**Who mentors are.** Mentoring was also reviewed in terms of who does the mentoring and how they are described. Traditional views of mentors are that mentors are more senior and experienced in a profession, supporting those who are less experienced and often younger in the profession (Onchwari & Keengwe, 2008). A more contemporary view describes mentors as equal in age and even equal in experience (Higgins & Kram, 2001; Smith, 2007). While the definition of mentor varies, the vision of mentor as supporter is consistent.

**Mentoring mathematics teachers.** The research on mentoring elementary school mathematics teaching is limited. The existing research focuses on mentoring and supporting preservice elementary mathematics teachers and only two studies were found. Hudson (2007) found five mentor practices which were effective for prospective elementary mathematics teachers, and Mewborn (2005) proposed specific strategies for mentoring preservice mathematics teachers. Clearly more research is needed in this area.

**Context and mentoring.** Lastly, this review examined the role of context on mentoring. Several studies have highlighted specific needs of schools in urban contexts (Yendel-Hoppy, Jacobs, & Dana (2009). It is not unreasonable to assume that specific mentoring is necessary to address specific issues within different school contexts. Alkins, et al. (2006); Saffold (2006); and Tillman (2005) all state that having mentors for teachers in urban schools increases retention. Research was identified that provides recommendations for preservice education programs to support prospective elementary school mathematics teachers (McKinney, Berry III, and Jackson (2007); however, recommendations for mentors of inservice elementary mathematics teachers were not found.

**Summary.** In summary proper mathematics education is vital for a society. Through mathematics education, young children are better able to compete globally. Their education is primarily a result of the learning opportunities provided by their teachers. For this reason providing mentoring support in mathematics for the teachers of elementary school children is vital.

### **Final Thoughts**

It is clear that mentoring is a dynamic process that has the ability to influence preservice and inservice elementary mathematics teachers (Mirra & Morrell, 2011). Reviews such as this that examine the mentoring programs are important to add pieces to the overall puzzle of mentoring elementary school mathematics teachers, particularly in urban contexts. As is evident, the current research does not examine differences in mentoring programs based on school context or other factors which potentially relate to marginalization. Given the changing demographics in the U.S. and the disparity between the socio-economics of the population being taught in urban schools and the population often teaching in these schools, it is critical that strategies be developed that support novice elementary teachers in these schools. It is also no longer sufficient to assume generic mentoring, without related content support, will provide the strong content and contextual preparation these teachers need. Much of the existing literature focuses on high school and middle school mathematics teachers. Of the existing literature on elementary school mathematics teachers, the focus has been on preservice teachers.

In general, future research is needed to specifically address mentoring teachers who teach mathematics at the elementary school level. Research is also needed to examine the relationship between mentoring elementary school mathematics teachers and mentoring in different school contexts.

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## CHAPTER 2

# A MIXED-METHODS EXAMINATION OF INSERVICE ELEMENTARY SCHOOL TEACHERS' MATHEMATICS MENTORING EXPERIENCES IN A MATHEMATICS DEGREE PROGRAM

### **Introduction**

From blackboards in one-room schools in the 1800s to Smart Boards in the 21<sup>st</sup> century, public education in the U.S. has evolved over time. This change has created a need for citizens of a thriving and growing nation to be mathematically literate. As defined by the Organization for Economic Cooperation and Development (2000) mathematical literacy is an individuals' capacity to identify and understand the role that mathematics plays in the world, to make judgments and to engage in mathematics that meets the needs of a person's life (p. 48). Mathematical literacy begins from the early educational experiences children have in the nation's public schools. Because of this importance, knowing how to best prepare and support teachers in their ongoing work of educating young children becomes vital. This study focuses on one aspect of supporting elementary school mathematics teachers that influences the creation of a mathematically literate nation: mentoring.

Over the past four decades mentoring of educators has been broadly researched. Scholars in the field of teacher development, such as Feiman-Nemser (2001), Glickman (2001), Ingersoll (2003), Strong (2009), and others have all added to the professional literature citing the need for enhanced teacher development and support in the form of mentoring. A primary reason for this need is the high rate of attrition among novice teachers. Teachers are graduating and entering the profession, but as a result of factors

such as lack of professional development opportunities, inadequate administration support, unequal access to resources, and lack of classroom autonomy, novice teachers frequently do not remain in the teaching profession (Ingersoll & May, 2011; Ingersoll & Perda, 2010). A second and equally viable reason for enhanced teacher development and support is the implications for and influence on student achievement. Rockoff (2008) found that student achievement in mathematics and reading was higher for teachers who received more hours of mentoring than those who received fewer hours. Finally, Ingersoll and Smith (2004) found that teachers in high poverty schools are less likely to report participating in mentoring and induction than those in low poverty schools, suggesting differences in teacher support across different demographics.

The *Principles and Standards for School Mathematics* (National Council of Teachers of Mathematics, 2000) provided benchmarks for the nation's mathematics teachers in order to best educate all children. The Teaching Principle from that document states "Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well" (p. 9). In this era of reform mathematics, teachers are encouraged to follow this principle; however, not all mathematics teachers are prepared and/ or supported in ways that make living by this principle possible. A second principle, the Equity Principle, encourages mathematics teachers to have high expectations and effective methods to support the learning of all students in mathematics (p. 12). When implemented effectively, these principles have the potential to influence children's mathematics learning, but implementation requires that teachers become highly effective teachers; a position not easily arrived at without support.

In elementary schools today most teachers teach a variety of subject areas. They teach not only mathematics, but also science, social studies, and language arts. However, elementary teachers seldom receive mentoring for a specific content area such as mathematics. They may attend workshops and have occasional professional development sessions, but ongoing training and support in the highly tested area of mathematics is not regularly done (Birman et al., 2007).

### **Purpose of the Study**

The purpose of this study is to describe the mentoring support provided in a mathematics master's degree and endorsement program for inservice elementary school mathematics teachers and to identify from the point of view of the teachers which attributes of the program were most effective. In contrast to other programs that offer mentoring support for teachers (Faucette & Nugent, 2012; Butler & Cuenca, 2012), the program described in this study provides a mentoring component specifically related to mathematics for all its students. Students have the opportunity to focus on one specific content area as they teach elementary school.

Most of the studies on mentoring look at mentoring in schools *in general*, describing what mentoring is and the different models and forms of mentoring (Barth, 2007; Gardiner, 2009; Hawkey, 1997; Rowley, 1999). Very few of those studies mention mathematics mentoring for practicing elementary school teachers, and of the few studies that do mention mentoring mathematics for teachers, the focus has been mostly on middle school and high school and on preservice teachers (Bennett, 2010; Hudson & Peard, 2006). Few studies were found that focus exclusively on mentoring *elementary* mathematics teachers. Additionally, mentoring has not been discussed in terms of school

context taking a critical lens (Ingersoll & Strong, 2011). It is reasonable to assume that some association between school context and the mentoring experience exists and the differences may impact the effectiveness of the mentoring. Because of these existing gaps in the literature, this study was designed.

### **Related literature**

Ongoing professional support for preservice and inservice teachers is a topic broadly researched over the past few decades. Specifically, research on support in terms of mentoring inservice teachers has gained considerable attention. Several aspects of mentoring found in the literature are relative to this study:

- Critical components of mentoring
- Mentoring in educational settings
- Who mentors are
- Mentoring of mathematics teachers
- The effect of context on mentoring

### **Critical components of mentoring**

Mentoring requires a specialized and unique body of knowledge that not every teacher has. Mentoring is a dynamic process that is both conceptual and contextualized. Gardiner (2009) asserts that a mentoring model involves a product and a process framework. In the product framework, mentees work as an apprentice to their mentors, and the process framework requires mentees to inquire and reflect upon their practices. With these two processes, novice teachers are able to build both the conceptual and practical aspects of their practice, thereby creating a superior basis for mentoring which ultimately creates the best support for teachers.

The building of a relationship and rapport between the mentor and the mentee creates the foundation for an effective mentoring experience (Onchwari & Keengwe, 2008; Hudson, 2007). Within the literature, great emphasis is placed on mentoring that begins from a foundation of a strong personal and professional relationship. Mentors have to help their mentee become comfortable and be willing to take risks in order for information, problems, and/or fears to be shared. A comfortable relationship works to enhance and promote a mentee's change of attitude toward a change in teaching practice (Ambrosetti & Dekkers, 2010). Once this paradigm shift is attained, the mentor is then able to learn the mentee's needs and support the mentee toward achieving his or her goals.

Research also suggests the need for mentors to have good interpersonal skills when working to establish a relationship with a mentee (Rowley, 1999; Hawkey, 1997). Some of those skills as identified by novice teachers in Ngara and Ngwarai (2012) were that mentors be approachable, open, effective communicators, good listeners, flexible, and knowledgeable of the teaching profession. These interpersonal skills make an impact on communication and the manner in which mentors respond to the needs of mentees.

Another key aspect of mentoring is for mentors to assume different roles as they work with their mentees. Ngara and Ngwarai (2012) identified several critical roles for mentors in the support of beginning teachers. One role is as counselor, someone who can help the mentee make sense of the professional world around them. A second role is a guider who helps lead the mentee in a productive direction. The networker directs the mentee in the direction of resources by assisting them to become acclimated to specific people and groups within the teaching profession. The participants in this study also

considered other important roles of mentors, such as viewing them as a role model and a constant giver of feedback. These roles help the mentee to have a model to follow, and they help the mentee to become aware of areas of achievement, as well as areas where improvement is needed within their practice. Ngara and Ngwarai also point out that mentors provide other critical supports that novice teachers need. They suggest this includes self-empowerment and reassurance, which helps the teachers know that they are capable of being successful at their job. Mentors need to act as advocates for the novice teacher, collaborators with the novice teacher, problem solvers with the novice teacher, and strategists with the novice teacher. All of these roles help the novice teacher to become reflective, critical, and confident within their practice.

### **Mentoring in Educational Settings**

Feiman-Nemser (2003) acknowledges that differences in mentoring programs exist in education. Some programs use retired teachers as mentors, while some use teachers who have classrooms but are released for some or all of their duties. Other programs also use full-time teachers, but do not release any responsibilities. All of these situations create differences in mentors' effectiveness.

Ngara and Ngwarai (2012) characterize three primary forms of mentoring. The first form is the apprenticeship model where a mentee works alongside their mentor and emulates the mentor. The mentee's practices and experiences are under guidance and supervised. The second form is the competency model where learning occurs based on pre-defined competencies that the novice teacher is expected to master. Lastly, the reflective form of mentoring involves support from a mentor that is coupled with ongoing reflection for the purpose of identifying flaws, weaknesses, strengths, and successes.

They point out that one form alone may not meet the needs of a mentoring program; aspects from each may be necessary for effective mentoring.

Feiman-Nemser (2012) also examines roles mentoring plays in different models of induction of novice teachers. In each of the models the mentor's role is based on different levels of support that is provided to the mentee. In one model of induction the mentor's role is very limited due to the demands of teaching that prevent the mentor from having as much time as needed to be involved. In this model, when the mentee needs help, the mentor assists. Because of this limited interaction, there are questions of whether the process is beneficial. In a second model, the mentor's role is more involved. This model is strategic and intentional and is based on the developmental needs of the novice teacher. In this induction model mentoring is based on important aspects that are cited in the literature. They include: matches between the mentor and mentee, advanced and ongoing training of mentors, and even physical proximity. Models that are based on these characteristics are known to have more impact on teachers and students (Glazerman et al. 2008; and Smith and Ingersoll, 2004).

Coaching is another dominant model of mentoring. Coaching is based on the premise of helping beginning teachers to improve their effectiveness by providing them with feedback on their practices to promote self-reflection and self-analysis (Veenman, de Laat, & Staring, 1998). Cognitive coaching, developed by Costa and Garmston (1994), is guided by the principle that once teachers' thought processes have been addressed, their behaviors can be influenced to improve their teaching practices. The process of cognitive coaching involves a three stage cycle. First, the coach (mentor) and the teacher have a pre-conference where the beginning teacher discusses areas in her instructional

practice she would like the mentor to focus on and provide assistance. Second, the mentor observes in the mentee's classroom, focusing on the areas discussed during the pre-conference. Finally, the mentee and mentor have a post-conference, where the observation is reflected upon and discussed. This type of process promotes self-reflection by the teacher and has been found to be most effective. Due to the specific focus of the intervention, the mentee is able to receive specialized attention and assistance rather than broad recommendations on practice.

Supervision is also considered a form of mentoring. Supervision as defined by Glickman (1990) is a function of schools that acts as glue, combining all the elements of instructional effectiveness. It is the process by which an individual (mentor) provides a link between the novice teacher needs and organizational goals for the ultimate success of the school. In Glickman's study the mentoring that is examined also pulls aspects of supervision within its practice. Glickman describes three philosophies related to supervision listed in order of the amount of control the supervisor holds: directive, collaborative, and non-directive supervision. Directive supervision relates to the existence of standards and competencies that teachers need to be effective. This situation is characterized by high supervisor responsibility and low teacher responsibility. Collaborative supervision is based on problem-solving between the supervisor and teacher. Here, the supervisor and the teacher have equal responsibility. And lastly, non-directive supervision places supervisors in the role of promoting private learning experiences rather than guiding or asserting. With this philosophy the supervisor's responsibility is low, and the teacher's responsibility is high. Glickman asserts that supervision requires knowledge, interpersonal skills, and technical skills.

### **Who mentors are**

Although there are many modes of mentoring, in the literature mentoring is most generally described as a relationship in which one person, who is more experienced in the teaching profession, helps and guides another person, who is less experienced, into the new profession (Hobson, Ashby, Malderez, & Tomlinson, 2009). In preservice teacher education programs mentoring is often linked to supervision, although some differences exist in the roles of a mentor and of a supervisor. While a supervisor may be involved in the development of a preservice teacher, Ambrosetti and Dekkers (2010) point out that the assessing plays a part in effectiveness. The supervisor judges the teachers' performance, thereby influencing the relationship that is formed. Ambrosetti and Dekkers maintain that the process of mentoring is based more on collaboration and development of the mentee through the building of rapport, whereas the supervisory role is mostly evaluative.

No single description of mentors exists in the literature, nor is there a single answer to who mentors are and what they typically 'look' like. However, traditionally in education, mentors are perceived as older, more experienced teachers, while the mentees are younger, more inexperienced teachers. In that role, mentoring is an intentional, nurturing, instructive, and supportive activity by the older more experienced person that helps shape the growth and development of the younger, less experienced person (Onchwari & Keengwe, 2008). Recent literature (Higgins & Kram, 2001; Smith, 2007) suggests that this stereotype of 'who mentors are' has changed over time, and the contemporary view of mentors is somewhat different. Mentors may also be co-workers, peers, or someone of equal status or age. Mentoring in this sense is a learning

opportunity where an experienced colleague socializes the learner to the larger context of the profession.

### **Mentoring Mathematics Teachers**

Research on the mentoring of mathematics teaching is limited. However, in relation to this study, a few studies highlight mentoring practices that were effective for prospective elementary mathematics teachers. Hudson and Skamp (2003) identified and justified a model that includes five factors with associated attributes/practices that are necessary for mentoring and used the model to develop the Mentoring for Effective Primary Teaching (MEPST) instrument. In Hudson, Skamp, and Brooks' (2005) study, 331 preservice teachers participated in completing the MEPST instrument. Ultimately, the MEPST was used to develop the *Mentoring for Effective Mathematics Teaching* (MEMT) instrument, which measures mentoring for mathematics as opposed to science (Hudson, 2007). In this study 29 final year preservice teachers were administered the MEMT instrument. The five factors identified on the instruments are as follows. (1) Personal attributes. This includes the mentor's ability to be comfortable talking and listening and being supportive. Positive personal attributes build confidence within the mentee and encourage reflective practice. In the era of mathematics reform, reflecting on practice is of particular importance for teachers to promote student learning (NCTM, 2000). (2) System requirements. This necessitate that the mentor be able to accurately and effectively communicate expectations of the school system to the mentee. (3) Pedagogical knowledge. This is the ability to articulate how the mentor prepares for teaching. It includes planning, teaching strategies, classroom management, assessment, and content knowledge. (4) Model appropriate teaching behaviors. This includes actions

such as creating teacher-student relationships, using suitable and appropriate classroom language, effectively planning, effectively teaching, and managing time and resources.

(5) Feedback. The mentor should provide written and oral feedback to the mentee. They should observe the mentee teach, review lesson plans, and provide expectations and advice (Hudson, 2007).

The five factors in the model proposed by Hudson (2007) could be applied to different disciplines because they are characteristic of effective mentoring in general; however, there are items on the survey that are specific and important to mathematics teaching and learning. For example, in category #4 (modeling) the survey specifically asks about modeling mathematics teaching and demonstrating hands-on learning experiences. These are characteristics of reform-based mathematics instruction that are important. Pedagogical knowledge is another category that could be specific to mathematics teaching. Shulman (1986) described a type of pedagogical knowledge this is important for teaching a particular discipline. He described that knowledge as pedagogical content knowledge, which is the specific knowledge and unique set of skills that teachers need to teach a subject effectively. Therefore, mentors exhibiting exemplary pedagogical knowledge specific to mathematics help novice teachers gain an understanding of the unique knowledge that is necessary for teaching mathematics.

Mewborn (2005) proposes what mentoring in mathematics should look like in preservice teacher education based on five years of data from an elementary school mathematics methods course. Similar to Feiman-Nemser (2001), Mewborn's preservice teachers participated in assisted performance, which allows prospective teachers to learn by engaging in tasks that they cannot do on their own without additional help. All of the

presented activities were useful as an alternative to traditional mentoring experiences. The instructor of the mathematics methods course proposed assignments that promoted discussion, reflection, and active involvement with young children as well as interactions with experienced teachers of mathematics.

### **Mentoring in Urban Contexts**

There is a particular need for mentors in urban school contexts where new, inexperienced teachers are often placed. Though many research studies cite the plight of working in urban schools, little research exists that confronts how effective mentoring might be as a strategy for addressing this dynamic. Atkins, et al., (2006) assert that mentoring is vital for teachers in urban schools who are at risk of leaving the profession. They used case studies to determine what support teachers need to be effective in urban schools. Through focus groups, interviews, and surveys, they found that teachers in urban schools oftentimes serve economically disadvantaged children, suffer from low morale, have limited resources, and experience differences in instruction implementation. Mentors who assist beginning teachers in these situations must address the challenges of working in these environments.

McKinney, Berry III, and Jackson (2007) highlight some effective mentoring practices to assist preservice teachers in learning to teach mathematics in urban high-poverty schools. In this study preservice elementary teachers provided written responses to interview questions to determine what practices are necessary for teaching in urban schools. Those recommendations include having more experiences in urban school settings, being paired with high quality mathematics teachers, and understanding the dynamics of high poverty schools. The authors acknowledge that preservice teachers

need field experiences and guidance by effective mentors to help guide them to understand the school, students, and community in urban environments. With those supports their instructional practices will be better aligned with the students' actual lived experiences (Ladson-Billings, 1995).

Yendel-Hoppy, Jacobs, and Dana (2009) studied a mentoring program which provided mentors to urban high, middle, and elementary schools which needed full-time mentors. The researchers identified three challenges that emerged as mentors enacted their work in urban school settings. One challenge involves what mentors face as they help their mentee survive challenging circumstances while focusing on student learning and accepting responsibility for their own actions. This challenge is present because the mentor concurrently experiences the same challenges of survival and success. They both are working to be effective educators, while the mentor is also working to support the teacher's growth. A second challenge is mentors helping their mentee be committed to social justice while navigating between survival and success. The last challenge involves mentors having the need to work with school leadership to foster a learning environment within the school. These challenges with the urban school context require that mentoring be a dynamic and ongoing process. For the survival of novice teachers, the placement, time and resources provided for mentors are crucial aspects of success.

### **Summary**

Mentoring was discussed in terms of how it has been defined in the literature, what roles of mentors have been identified, as well as the traditional versus the more recent view of mentors. Through synthesizing the literature the definition of a mentor and its role is a dynamic, yet complicated one. In summary, mentoring is based on a process

where an experienced educator guides a less experienced educator in the education profession. It is clear that mentors must assume many different roles, responsibilities, and characteristics while creating this transformation. Also, the relationship that is built between a mentor and a mentee is vital and influences the effectiveness of the work that is carried out.

Additionally, this review discusses the role of mentoring mathematics teachers and mentoring in urban contexts. According to the literature school context seems to influence the type of mentoring that teachers receive. While there is an abundance of existing literature that focuses on mentoring in general, the area of mentoring for mathematics teachers is very limited, particularly for elementary school teachers. Much of the existing literature focuses on high school and middle school mathematics teachers. Given the findings of Atkins, et al., (2006); Hudson (2007); Mewborn (2005); and Yendel-Hoppy, Jacobs, and Dana (2009), it is clear that future research is needed to specifically address mentoring teachers who teach mathematics at the elementary school level, as well as to examine the relationship between mentoring elementary school mathematics teachers and mentoring in different school contexts.

### **Research Questions**

The following research questions are raised to address the gap in the literature described above.

1. What are practicing elementary teachers' perceptions of the mentoring they received in mathematics teaching as part of a master's program?
2. What attributes of mathematics mentoring were found to be most effective by elementary school mathematics teachers?

3. Does school context influence the mentoring experience of elementary school mathematics teachers? If so, in what way(s)?

## **Methods**

### **Participants and Site**

This study involved 26 female elementary teachers (55% of graduates) who are graduates of a Master's in Elementary Mathematics with an embedded mathematics endorsement program at a major university in the southeastern United States. The program is five years old, and there are 47 graduates. The program is for certified teachers, and graduates of the program receive a Master's degree and endorsement in mathematics for elementary education. The program also has a separate route for students who wish to only obtain a mathematics endorsement; however, no participants in this study participated in that route. According to the program's website, the focus of this Master's and endorsement program is to engage students in research, exploration, and practice in elementary mathematics in diverse classrooms, and to develop highly qualified mathematics teachers and teacher leaders consistent with NCTM and NAEYC national standards.

A requirement of the Master's degree includes an internship/mentoring course in which each student in the program is required to participate. This component of the program requires mentoring by an experienced mathematics teacher educator who (in most cases) is also an instructor in the program. The mentoring experiences occur over the course of a semester and involve the following aspects: (1) Two scored classroom observations. These teaching observations are scored using a standardized observation instrument (Appendix A) that was designed specifically for the Master's program. It is

used to capture elements of the classroom and lesson such as, classroom demographics and context and a description of the lesson and classroom events. The duration of the observation varies amongst each student but is one entire mathematics lesson. (2) Post-observation conferences. After the observations, the mentor conducts a conference with the teacher to discuss strengths and weaknesses of the lesson. (3) Professional teaching portfolio. Each teacher creates an electronic portfolio which contains documents justifying mastery in eight categories of performance. The categories in the portfolio are: content implementation, observed lesson, impact on student learning, improving lesson impact, planning technology integration, communicating technology use to parents, experience across grade levels, and experience with diversity. Additionally, the electronic portfolio is scored by the mentor. This type of mentoring resembles a competency model described by Ngara and Ngwarai (2012), where there are predefined concepts to master, and a reflective model, where the teacher reflects upon practice for improvement while working with their mentor. In addition, the effectiveness of the mentoring and the relationship between the mentor and mentee may be affected by the assessment (Ambrosetti & Dekkers, 2010).

### **Recruitment**

All graduates of the program were asked to participate in this study. All of the graduates were invited to complete the online survey instruments via email, and they were asked to indicate by leaving an email address if they would like to participate in the interview. Up to two additional emails were sent in order to gain the maximum amount of participants as possible. General demographics are provided in Appendix C.

## Data Collection

The study included three data sources: a demographic survey, a mentoring survey instrument, and an interview. The data sources are described in detail in the following sections.

**Survey Instruments.** All who agreed to participate were asked to complete the Mentoring for Effective Mathematics Teaching (MEMT) survey instrument (Appendix B). The MEMT is a 34-item Likert scale instrument that was designed for preservice teachers and adapted from a series of studies that produced a science mentoring instrument, *Mentoring for Effective Primary Science Teaching* (MEPST) (Hudson, 2003; Hudson & Skamp, 2003; Hudson, 2004a, b; Hudson et al., 2005). The only adaptation the researchers made from the MEPST was the replacement of the word “science” for the word “mathematics” in all questions. For example, one item in the original science instrument asks “During my final professional school experience in science teaching, my mentor guided me with science lesson preparation.” This was replaced with “During my final professional school experience in mathematics teaching, my mentor guided me with mathematics lesson preparation”. Validity and reliability are reported for the MEPST.

The original developers of the instrument used reviews of literature, interviews with educational experts, mentors, and mentees to develop validity for the instrument (Hudson, 2005). The subscales of the instrument, Personal Attributes, System Requirements, Pedagogical Knowledge, Modeling, and Feedback, all have high reliability, with Cronbach Alpha scores of 0.91, 0.77, 0.95, 0.90, and 0.86 respectively. Correlations and co-variances of the five subscales were statistically significant ( $p < .001$ ) (Hudson, 2007). Additional questions obtaining demographics information to inform

participant selection for the interviews are included in a demographics survey (Appendix C).

**Interviews.** Four (4) of the participants (15% of the participants) volunteered to participate in an audiotaped interview. Originally, purposeful sampling was planned in order to ensure the voices of teachers from contrasting school contexts were heard. Due to actual interview volunteers, purposeful sampling was not possible or necessary. Two of the participants were African American, female teachers in low socio-economic, urban schools, and the remaining two participants were Caucasian, female teachers in affluent, suburban schools.

The interview was semi-structured and audiotaped. According to Roulston (2010), for semi-structured interviews, researchers refer to an interview protocol, which contains a certain number of questions. These questions are open-ended, and the interviewer follows up by probing in order to seek more detail about the responses. Therefore, in this study additional probing questions were posed and were different for each participant. Informed by the MEMT survey instrument, some sample questions for this interview are as follows (a) “In relation to your mathematics teaching ability, how important was it that that your mentor have an understanding of current system requirements such as school/district policies and curriculum in mathematics?” (b) “What influences your ability to implement in your classroom the strategies you learned from your mentor?” (c) “What are some personal characteristics of a mentor that you think are important for effective mentoring in mathematics?”

Overall, the interview was designed to illuminate the same domains as the survey instrument, i.e., (a) Personal Attributes, (b) System Requirements, (c) Pedagogical

Knowledge, (d) Modeling, and (e) Feedback as well as to provide further clarity and information regarding participants' ability to enact their work within their specific school contexts. Other interview questions are included in Appendix D.

### **Data Analysis**

Data from this study were analyzed using analysis and interpretation procedures that are appropriate for Explanatory Design mixed methods studies (Creswell, Plano Clark, et al., 2003). In this type of study the qualitative data collection follows quantitative data collection with interpretation emphasizing the quantitative results. Table 1 illustrates how each data source was used to answer the research questions of the study. The quantitative portion of the study was analyzed using the statistical software SPSS. Descriptive statistics, such as means and standard deviations were provided for the five subscales, as well as for each individual item. Cronbach's alphas were determined for the five subscales in order to measure the internal consistency of the survey items to the scales.

The qualitative data from the study were analyzed using inductive analysis through a Constant Comparative Method (Roulston, 2010). This approach focuses on using documents, such as memos, and interview transcripts to determine patterns. In order to accomplish the Constant Comparative Method of analysis, the following actions were taken. (1) Interviews were conducted and transcribed. (2) Once transcribed, the interviews were read line by line multiple times, and initial codes were determined from the data and included in an initial coding manual. (3) Each code or category was then compared to previous incidents that had been coded in the same manner. (4) Memos explaining developing ideas about the data were written during the entire coding process

and used to compare categories that have been developed during the coding process. (5) Comparisons were made until no new incidents in the data added to aspects of the developing conclusions. Using the Constant Comparative Method, the interview data were then used to address research question #3, comparing the experiences of participants from the different school contexts and focusing on differences between contexts that are more and less marginalized, specifically regarding race and class (Bogdan & Biklen, 2007).

In summary, the interview data and the survey data were interpreted sequentially using the interview data to explain and help make sense of the survey data. This method of Explanatory Design allowed qualitative themes to support findings from the quantitative results (Creswell & Plano Clark, 2007). For example data obtained from the interviews were compared to the data obtained from the surveys in an effort to discover similarities and differences in the responses that participants provided between the two data sources.

Table 1  
*Research Questions and Data Sources Table*

Research Questions	Data Sources	
	Interview	MEMT Survey Instrument
1. What are practicing elementary teachers' perceptions of the mentoring they received in mathematics teaching?	X	X
2. What attributes of mathematics mentoring were found to be most effective by elementary school mathematics teachers? What attributes were least effective?	X	X
3. Does school context influence the mentoring experience of elementary school mathematics teachers? If so, in what way(s)?	X	

## Results

### Quantitative results

This section presents results from the MEMT survey and will be used to clarify the following research questions.

1. What are elementary teachers' perceptions of the mentoring they received in mathematics teaching?
2. What attributes of mathematics mentoring were found to be most effective by practicing elementary school mathematics teachers? What attributes were least effective?

Scores for the MEMT were summarized according to the five subscales of the survey using a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree). The subscales are Personal Attributes, System Requirements, Pedagogical Knowledge, Modeling, and Feedback.

For each subscale, means, standard deviations, and Cronbach's alpha were determined (see Table 2). Supporting Hudson's (2007) findings, each of the five subscales had acceptable Cronbach's alpha coefficients greater than 0.70, indicating high levels internal consistency (Kline, 1998). The subscales, Feedback and Personal Attributes had the highest means (4.40 and 4.32 respectively), while System Requirements, Pedagogical Knowledge, and Modeling had slightly lower subscale scores of 3.64, 4.02, and 4.06 respectively.

**Personal Attributes.** Within the six dimensions of the Personal Attributes subscale, 85% of the mentees perceived their mentor to be supportive of their mathematics teaching. The dimensions with the lowest percentages within this subscale

Table 2  
*Five factors for Mentoring for Effective Mathematics Teaching (n=26)*

Factor	Mean Scale Score	SD	Cronbach's Alpha
Personal Attributes	4.32	0.93	0.97
System Requirements	3.64	1.02	0.90
Pedagogical Knowledge	4.02	0.92	0.97
Modeling	4.06	0.85	0.96
Feedback	4.40	0.73	0.93

were assisting in reflecting and listening attentively, with 77% of the mentees agreeing or strongly agreeing with both of those practices. Additionally, the highest percentage of mentees (88%) perceived that their mentor made them feel confident in their mathematics teaching. Table 3 provides mean scores, standard deviations, and the number and percentage of mentees who agreed or strongly agreed with the six dimensions.

**System requirements.** In the three dimensions of the subscale System Requirements, the dimension “outlined the curriculum” had the fewest participants (27%) who agreed or strongly agreed with the statement (Table 4). Eighty-five percent of the participants indicated they agreed or strongly agreed that their mentor discussed the aims of mathematics teaching and 81% indicated they agreed or strongly agreed that the mentor discussed school policies for mathematics teaching,

Table 3  
*“Personal Attributes” for Mentoring for Effective Mathematics Teaching (n=26)*

Mentoring Practices	Survey item number	% Agreed or Strongly agreed	Mean Score	SD
Supportive	1	85	4.19	0.69
Comfortable in talking	17	88	4.27	1.28
Assisted in reflecting	23	77	4.23	0.99
Instilled positive attitudes	22	88	4.38	0.98
Listened attentively	31	77	3.96	1.31
Instilled confidence	26	92	4.46	0.86

Table 4  
 “System requirements” for Mentoring for Effective Mathematics Teaching (n=26)

Mentoring Practices	Survey item number	% Agreed or Strongly agreed	Mean Score	SD
Discussed aims	25	85	4.23	0.71
Discussed policies	4	81	4.46	1.12
Outlined curriculum	11	27	2.65	1.41

**Pedagogical knowledge.** The subscale of Pedagogical Knowledge (Table 5) has 11 dimensions. All of the participants (100%) agreed or strongly agreed that the mentor ‘provided new viewpoints’ on teaching mathematics. Other examples of mentor practices which received high numbers of mentees who agreed or disagreed were: discussing problem solving, content knowledge, teaching strategies, planning, and questioning. The dimensions of assisting with timetabling and classroom management appeared to be the practices least used by mentors within this subscale, with only 38% and 23% of the participants agreeing or strongly agreeing.

Table 5  
 “Pedagogical knowledge” for Mentoring for Effective Mathematics Teaching (n=26)

Mentoring Practices	Survey item number	% Agreed or Strongly agreed	Mean Score	SD
Guided preparation	3	73	4.0	1.17
Assisted with classroom management	6	38	3.19	1.02
Assisted with teaching strategies	14	85	4.23	0.91
Discussed implementation	8	85	4.23	1.70
Assisted with timetabling	10	23	2.54	1.36
Discussed problem solving	27	88	4.38	1.10
Assisted with planning	24	85	4.31	1.56
Provided viewpoints	30	100	4.62	0.50
Discussed assessment	32	77	4.0	1.26
Discussed questioning techniques	18	85	4.31	0.74
Discussed content knowledge	21	88	4.46	0.71

**Modeling.** Within the modeling subscale, all of the participants acknowledged that their mentor used mathematics language from the syllabus. Almost all (24) of the participants indicated that their mentor modeled mathematics teaching. This result was similar to results on the mentor practice of modeling *effective* mathematics teaching, where again almost all of the participants indicated that their mentor practiced. Practices such as modeling classroom management and modeling rapport with students were the practices which the least numbers of participants indicated their mentor to practice (Table 6).

**Feedback.** Lastly, in the subscale feedback, all 26 of the participants were observed teaching mathematics before receiving feedback. Most (25) of the participants perceived their mentor to have discussed evaluation of their mathematics teaching (Table 7). In addition, most perceived their mentor to have provided written feedback on their mathematics teaching. The mentor practice that was perceived to be experienced by the least number of mentees was reviewing lesson plans where only 15 of the participants agreed or strongly agreed.

Table 6  
“Modeling” for Mentoring for Effective Mathematics Teaching (n=26)

Mentoring Practices	Survey item number	% Agreed or Strongly agreed	Mean Score	SD
Used syllabus language	2	100	4.54	0.51
Modelled math teaching	5	92	4.42	0.86
Modelled rapport with students	7	65	3.69	1.22
Displayed enthusiasm	9	81	4.19	1.02
Modelled classroom management	12	23	2.35	1.35
Modelled effective teaching	15	92	4.42	0.78
Demonstrated hands-on	19	88	4.42	1.14
Modelled well-designed lesson	29	92	4.5	0.65

Table 7  
*“Feedback” for Mentoring for Effective Mathematics Teaching (n=26)*

Mentoring Practices	Survey item number	% Agreed or Strongly agreed	Mean Score	SD
Articulated expectations	33	85	4.19	1.06
Observed teaching for feedback	34	100	4.65	0.49
Reviewed lesson plans	28	58	3.85	0.83
Provided written feedback	20	92	4.42	0.64
Discussed evaluation	13	96	4.35	0.56
Provided oral feedback	16	81	4.42	0.99

### Summary of the Quantitative Findings

Results from the quantitative research show that mentees perceived their mentors provided several of the mentoring practices from the MEMT instrument. All five subscales have factors which the mentees perceived their mentor practiced. Scales such as “Feedback” and “Personal Attributes” have the highest mean scores, while “System Requirements,” “Pedagogical Knowledge,” and “Modeling” have the lowest mean scores. Additionally, all 26 of the participants perceived their mentor provided certain mentor practices such as “Provided viewpoints,” “Used syllabus language,” and “Observed teaching for feedback.” However, less than half of all the mentees perceived their mentor provided the practices: “Outlined the curriculum,” “Assisted with classroom management,” “Assisted with timetabling,” and “Modeled classroom management.”

### Qualitative findings

Interviews were initially analyzed using a Constant Comparative Method (Roulston, 2010) and revealed three overall themes: 1. Characteristics of effective mentors, 2. Expectations about teaching and learning mathematics, and 3. Teaching mathematics in different contexts. This section will describe those themes. Table 8 below will illustrate how each theme contributes to each of the research questions.

Table 8  
*Analysis of Themes using research questions*

Themes	Research Questions		
	What are practicing elementary teachers' perceptions of the mentoring they received in mathematics teaching?	What attributes of mathematics mentoring were found to be most effective by elementary school mathematics teachers?	Did school context influence the mentoring experience of elementary school mathematics teachers? If so, in what way(s)?
1. Attributes of effective mentoring experience	X	X	
2. Expectations about teaching and learning mathematics	X		X
3. Teaching mathematics in different contexts	X	X	X

### **Attributes of effective mentoring experience**

**Characteristics of mentors.** Throughout the interviews, several characteristics of an effective mentor in mathematics emerged. These included knowledge of and mentoring in mathematics, knowledge of the school context, understanding the mentees needs, knowledge of the mathematics curriculum, providing honest feedback, and being approachable.

All the interviewees mentioned that the mentor should have knowledge or experience both in teaching and in mentoring in mathematics. The mentor should, “be proficient in using the math methods that they are explaining” (Teacher 2). Another participant stated, “They have to know what they’re talking about.” She explained that “they should have experience using that knowledge, like someone who has taught many

years or somebody who has mentored people before. That's really important" (Teacher 1).

In addition to having knowledge and experience in teaching and in mentoring in mathematics in general, one participant reported a potential difference in the type of mentoring needed for teachers who teach in different school contexts. This participant noted the importance of a mentor having experience not only with the specific subject, but also with a specific school context in terms of ethnicity, particularly with Black students:

I think that the mentors first and foremost have to have experience in what they're going to be instructing in. By experience, I don't just mean teaching them mathematics methods, but maybe experience of the context, experience with working with the Black population. They have to have worked with Black students in order to understand how to reach them, effectively reach them (Teacher 3).

When probed to expound upon her response regarding school context, the participant responded, "The [black] population is unique from some others in that you have to find a way to relate to them to teach a lot of them." This participant believed that in order to teach students effectively, one should have knowledge or experience to relate to that specific population of students.

When asked if there was particular importance for mentors to have knowledge of system requirements, such as school policies in order to help improve the mentee's teaching ability, all of the participants believed it was not as important as having other

types of knowledge. Other factors were more important, such as understanding teacher's needs,

I would say an understanding of my needs, in order to navigate them would have to be absolute. While I find it difficult to have to memorize every single school and district's mandates and responsibilities, I wouldn't expect that [system knowledge], but at least understand what I have to go through while teaching here. (Teacher 3)

Due to the state's change in curriculum at the time from Georgia Performance Standards (GPS) to Common Core Standards (CCGPS), one participant viewed having knowledge of the curriculum as being more important than knowledge of the school's policies, "At the end of the day it's really about the curriculum." She continued to explain, "Knowing the curriculum was very important, especially at that time. We were just transitioning to the Common Core. So, it was really, really important that they understood common core because we didn't" (Teacher 4).

Another important characteristic of mentors that the interview participants found to be important for effective mentoring was receiving honest feedback. The participants were committed to making change in their practice. One participant wanted to know "truthfully how I did so I can get better with my math teaching ability" (Teacher 2). The participants believed that it's important to have a mentor who is, "honest enough to be able to tell you when you're doing something wrong so you can work on it" (Teacher 4). They wanted a mentor who wouldn't always say, "Everything's great," but one who was "not afraid to tell me that you're doing this wrong. You could improve in this area."

According to the participants, being approachable was yet another characteristic of mentors that they described as important. The mentor should be someone “I feel comfortable calling when I have a question” (Teacher 4). One participant believed that the mentor should be available to students in the program when needed, “I think mentors have to be around when they’re needed, or at least reachable. I would like to know that I can reach them when I need some help with my math teaching” (Teacher 1).

One final characteristic that was deemed important by the some of the participants was having a relationship, “to be able to connect with me, to be interested in me becoming a teacher, me being an excellent teacher and all of the above” (Teacher 3). Another participant mentioned, “how important it would be to be able to relate to my mentor and my mentor relate to me. It’s just like being in the classroom and having to relate to students”. She sums up the response by stating, “Relationships are important” (Teacher 1).

**Improving teaching practice.** While certain personal characteristics of mentors were found to be important for effective mentoring in mathematics, improving teaching practices was also a theme that emerged repeatedly in the data. When asked about the importance of their mentor helping them increase their pedagogical knowledge for teaching mathematics, most (3 of 4) of the participants stated it was important to increase their pedagogical knowledge, and that their mentor in the program helped them build their pedagogical knowledge for teaching mathematics, “It was really important for me to get feedback and take full advantage of it. You can see the difference in my students in several ways now” (Teacher 2). Another participant explained how she was able to improve after being observed teaching in just one instance, “She gave extremely detailed

suggestions as to how I could improve. She could see what was happening and help me make connections just by seeing me one time in the classroom. My knowledge definitely increased throughout that time” (Teacher 4).

One participant did not feel as though her mentoring experience increased her pedagogical knowledge for teaching mathematics. While she admitted that “it was extremely important to build upon my knowledge,” she believed the mentor did not assist her in doing that but rather seemed to be there “for a system of checks and balances. I don’t think [the mentor] was necessarily there to help me become a better teacher” (Teacher 3). This participant felt that increasing pedagogical knowledge was important, she did not feel her experience with her mentor supported her in that respect.

Lastly, modeling mathematics teaching was also found to be an important aspect of mentoring to improve teaching practice. All of the participants described the importance of their mentor modeling effective mathematics teaching. Although unlike many mentoring situations where the mentor might teach in another classroom in the school or offer to model teach in the mentee’s classroom, the modeling in this case occurred with adults in a university classroom. However, all the participants found that the modeling helped change their viewpoints on teaching, and as one participant stated, “seeing her do it helped me see how I could teach my kids that because I was coming from really straight forward, here are your steps, type of teaching”(Teacher 4). While another participant commented on the connection to her learning style, “the fact that we did it in class was really helpful because for me I’m just a hands-on learner. I like to see things, so it was really helpful for me that we would actually go through the projects in class” (Teacher 2).

### **Expectations about teaching and learning mathematics**

The second major theme that emerged from the interview data was expectations about teaching mathematics and the alignment of the school's expectations to those of the mentoring experience. Both of the teachers who taught in schools with low minority and middle to high socio economic status students answered similarly about the expectations for teaching mathematics at their school. One participant said she felt very fortunate because her "principal was extremely open to whatever and she loved seeing different learning experiences taking place. All she cares about is if the kids are learning, no matter how you get them there" (Teacher 1). The second teacher explained, "there were no real mandates on what we did. There was no textbook, and we could do just about whatever we wanted to do so long as the kids were progressing. It was nice to have that autonomy to be able to try out different things" (Teacher 4). The experiences of those teachers indicated a high level of autonomy and trust as well as an emphasis on student learning.

However, teachers at schools with high minority students from low socio-economic status households found the expectations for teaching math at their school were either conflicting or based on reaching certain achievement goals. One participant described the expectations as:

What they said versus what they wanted us to do was a little bit different. So for instance, they said that they wanted it to be very student focused, student led and things like that, but at the end of the day it was like here's this test. They need to pass this test. (Teacher 2)

The other participant described the expectations as being based on whether or not the students "passed or excelled on the CRCTs" (Teacher 3). The expectations at her

school were “around the achievement of targets, so there was no expectation to a type of teaching. There was no norm about this is what a strong math lesson looks like. It was mostly, your kids needed to pass and that is it.” The expectation of teaching at these schools was that students needed to pass the standardized tests.

In addition, one participant noted discrepancies between the expectations that school leadership verbalized and what school leadership actually expected. She explained that even though the school valued high level learning, less challenging assessments were utilized to assess student learning:

“...even though they wanted to be so different, what they required them to do still wasn't very high performing. Do you know what I mean? It wasn't very rigorous of what required of them. Kind of like multiple choice type questions. Whether we taught it cognitively or not, they would have been able to kind of figure that type of stuff out. What they said versus what they delivered was different from the school level” (Teacher 2).

### **Teaching mathematics in different school contexts**

The third major theme that emerged from the interview data was if and how the mentoring experience influenced the teacher's ability to teach mathematics in different school contexts. In this study the participants were asked specifically about teaching students in schools with high numbers of minority students of low socioeconomic households. Three of the four interview participants found that the mathematics methods they were taught could apply to students in any context. One participant attributed that to the types of strategies she learned, “Because there are so many strategies it leaves that openness for anybody to pick up which one works best for them... students of all

demographics who were able to do the math and you just saw that it surpassed all barriers”(Teacher 4). Another participant noted the influence of the strategies by commenting on the relevancy of the tasks to the student’s lives, “I have never taught in a different type of school, but I could see how the problems we used would gauge anyone’s interest. I would have loved math if I were taught that way” (Teacher 1).

While most of the interview participants found the mentoring experience directly promoted student learning in the classroom, regardless of context, one participant did not. When asked if her mentoring experience promoted her ability to teach in different school contexts, she replied negatively, suggesting that “there was no relationship built,” between her and her mentor. She went on to say that the mentoring did not positively influence her ability to teach mathematics in her current context. She described the mentoring experience as “a matter of checks and balances” and believed the mentor was simply there in order to “go and observe her, fill out this form, and then it’s going to be done” (Teacher 3).

### **Summary of Qualitative Results**

The interview data revealed major themes centered from the participants’ mentoring experiences. These major themes provided information to help clarify the original research questions. The first theme that emerged was *characteristics of effective mentoring*. The interview participants revealed that mentors should possess certain personal characteristics in order to have a successful mentoring experience, e.g., having knowledge of and experience in teaching mathematics and in mentoring, providing honest straightforward feedback regarding the teacher’s teaching practices, being

approachable so that the mentee can feel comfortable seeking assistance, and forming a relationship with the mentee.

The second major theme, *expectations about teaching and learning math*, provided insight about the expectations for teaching math at the participants' schools as well as the alignment of the mentoring experience to the expectations of the school. Most of the teachers in this study (3 of 4) acknowledged having a bit of autonomy to teach using methods that worked best for their situation. While school leadership at two of the schools placed emphasis on student learning, the other two schools focused on producing results on standardized tests. One teacher acknowledged discrepancies in the expectations for learning at her school.

Lastly, information about school context, specifically related to the socioeconomic status and ethnic make-up of the students, was revealed in the final theme, *teaching mathematics in different school contexts*. Most of the teachers found that their mentoring experience influenced their ability to effectively teach in a variety of school contexts based on the strategies they had learned within the experience. However, one teacher did not find that her experience influenced such teaching.

### **Discussion**

The research questions will be used to guide interpretation of the findings. In addition, the results from this study will be interpreted by using themes from the qualitative results to support the quantitative results. Similarities between the findings from two data sources will be discussed.

**What are practicing elementary teachers' perceptions of the mentoring they received in mathematics teaching?**

Overall, the mentees revealed positive accounts of their mentoring experience. Most found their mathematics teaching practices, pedagogical knowledge, and dispositions about teaching mathematics improved. They argued that their experience with a mentor helped them to be confident to be able to apply the learning in different settings. This supported findings from the survey on the scales Pedagogical Knowledge, Modeling, and Feedback which all indicated that the teachers perceived experiencing several of the mentor practices associated with those scales, e.g., “discussed content knowledge,” “used syllabus language,” and “provided written feedback.”

However, one participant’s experience was not as positive as the others. Overall, she did not believe that her mentor experience increased her abilities to teach mathematics. Negative mentor experiences such as this particular participant’s experiences would account for the practices on the MEMT with the most variance, e.g., “discussed implementation” and “listened attentively” and suggests that at least some other participants had a similar experience.

Other possible explanations for the high variance of certain practices on the MEMT include the overall aims of the Master’s program as well as the specific needs of the mentees. According to the Master’s program’s website, the focus of the program is to increase content knowledge, pedagogical knowledge, skills and dispositions for teaching mathematics. Therefore, certain practices on the MEMT are not be directly related to the program, e.g., the scale “system requirements.” This explanation specifically supports findings from the factor, “Outlined the curriculum,” which had a low mean score (2.65). Also, adult learners have specific learning needs (Knowles, Holton, Swanson, 2005). This would require their learning experiences to have matched their specific needs.

Without a specific connection with participants' needs, the mentoring experience may not have been perceived positively.

**What attributes of mathematics mentoring were found to be most effective by elementary school mathematics teachers?**

The elementary school teachers who participated in this study revealed several interesting ideas regarding the attributes of an effective mentoring experience for mathematics teaching. Through the interviews, participants revealed certain aspects of a mentoring experience that they found to be important for mathematics teaching.

“Personal characteristics of mentors” and “improving mathematics teaching practices” were the two main categories that were identified as attributes of an effective mentoring experience. These aligned with results from the MEMT.

**Personal characteristics of mentors.** Related to personal characteristics of mentors, all of the participants noted the importance for mentors having specific knowledge for teaching mathematics. Ball (1990, 1991) calls this knowledge *specialized content knowledge* (SCK), which is the unique knowledge needed for teaching mathematics. As supported by the MEMT survey instrument, most of the participants found that their mentors discussed specific knowledge and teaching strategies needed for teaching mathematics. Not only did the participants note discussing the content knowledge and strategies needed for teaching mathematics, but they also discussed the knowledge needed for assessing, questioning, and implementing those strategies in the classroom.

Other characteristics that were found to be important from the qualitative data include mentors providing honest feedback, being approachable, and forming a

relationship with the mentee. Most of the mentees who were interviewed pointed out their desire to grow through receiving honest and strategic feedback about their teaching. They mentioned the importance of knowing not only the positive aspects of their abilities, but also the areas where they could improve. The MEMT survey data revealed that most of the participants were given feedback on their teaching practices in both oral and written form. In addition, in the survey most of the participants indicated they did not receive feedback on their lesson plans, but they did indicate that methods for improving their teaching were clearly articulated by their mentor. Though being approachable and having a relationship were not components of the survey instrument, previous literature on mentoring has revealed that those interpersonal skills are important aspects of mentoring (Rowley, 1999; Hawkey, 1997; Ngara and Ngwarai, 2012).

**Improving teaching practice.** Most of the interview participants in this study acknowledged that improving their teaching practice was an important aspect of their mentoring experience. This improvement was a result of different aspects of the mentoring experience. With increased pedagogical knowledge, participants found that their capacity for teaching mathematics increased. Through information received in classes with the mentor, feedback from observations, and conversations with the mentor, participants found their practice to be improved. This finding is supported by the quantitative results. According to the survey instrument, the factor “Pedagogical Knowledge” scored high with a mean scale score of 4.06 indicating a large percentage of participants agreed or strongly agreed with the associated mentor practices, such as “developed my strategies for teaching mathematics” and “gave me new viewpoints on teaching mathematics.”

Additionally, through seeing specific teaching strategies modeled by their mentor, interview participants were able to learn new skills and apply the learning with the young students in their classes. By seeing the mentor facilitate activities and through explanations on teaching and assessing, the mentees found that they were able to improve their practice. The modeling factor of the MEMT also supported those results with a high mean scale score, indicating most of the participants perceived their mentor to have incorporated most of the modeling mentoring practices.

**Did school context influence the mentoring experience of elementary school mathematics teachers? If so, in what way(s)?**

The teachers interviewed in this study represent dissimilar contexts. In those interviews both pairs revealed uneven expectations for teachers from the school leadership. The two teachers in the high minority, low income schools mentioned the expectations of school leadership to have students prepared for a state test, suggesting a lack of focus on overall student learning. While the expectations for teaching of the two teachers in the low minority, middle to high income schools were centered around overall student learning, the expectations for teaching of the other group (high minority, low income) were centered around passing a test, suggesting that school context is an important factor in the type of mentoring needed to help navigate such expectations. It also highlights a reality of schools that have a high number of minority and students of low-socioeconomic status households. Though these schools may promote student learning, pressures on student achievement through tests creates an added burden that may, in essence, take away from what is known to be effective teaching. Understanding the dynamics of such schools is important. Mentors are needed who can not only help

teachers navigate the pressures of the school context, but also understand the students within that context, and support effective mathematics teaching practices, an overwhelming charge.

Using *only* school context, however, does not give a complete picture of the mentoring that is needed. One of the two teachers who taught in a school context of high minority, specifically Black students from low socio-economic households, found the mentoring experience increased her ability to teach mathematics to the students she served. She mentioned how the math strategies that she learned could be applied to all students regardless of context, and how her knowledge base and confidence had increased. The other teacher who taught in a similar context found that the mentoring experience did not lend itself to influencing her ability to teach her students. She perceived her mentoring to be more focused on the completion of tasks rather than a personalized approach to helping her grow within her practice, and she believed that it did not support her particular school context. It appears she needed help navigating the expectations of teaching her students while following the school's expectations, and using what she learned through the program to be an effective mathematics teacher. This highlights the very individualized approach needed by mentors, even with mentees in similar contexts (McKinney, Berry, & Jackson, 2007).

### **Conclusion**

This mixed-methods study was conducted in order to examine the mentoring experiences of a group of inservice elementary teachers who were mentored in mathematics as part of their master's program experiences. The purpose was to understand the perceptions of the mentoring experience specific to mathematics of the

teachers, to understand which attributes of mentoring they found to be effective, and to understand if context played a role in their mentoring experience. The study used an explanatory design comprised of a survey instrument (quantitative) that was informed by an interview (qualitative).

The interviews generally supported the MEMT results and identified attributes of effective mentoring in mathematics that were important for the participants. Personal mentoring characteristics such as providing honest feedback, having mathematics content and pedagogical knowledge, and supporting teachers as they attempted to improve their practice were identified. Those findings support general characteristics of mentors found in previous literature, such as having good interpersonal skills, increasing teaching capacity, and attending to the needs of adult learners (Hawkey, 1997; Ngara and Ngwarai, 2012; Knowles, Holton, & Swanson, 2005). The interviews also helped us understand and interpret the survey data, particularly where wide variance occurred.

However, for this population, content specific knowledge *combined with* context specific knowledge *combined with* individual needs of the mentee appear to be critical mentor characteristics that have not been clearly identified in the literature and warrant further research.

### **Limitations**

There are limitations in this study. The student researcher matriculated through the Master's program that was studied, perhaps impacting his ability to distance himself from the analysis. Since the participants had already matriculated, recruitment of participants occurred through email, limiting the number of participants and limiting the ability to make generalizations about all the graduates of this Master's program. Finally,

the survey instrument, MEMT, was originally designed for the preservice teacher population. We used it with practicing teachers without modifications. Future research would be needed to account for these limitations in order to better understand will need in order to best serve all of its elementary mathematics teachers. This includes, if needed, modifying the survey instrument to better align with mentor practices needed for inservice teachers, having a larger sample size for both quantitative and qualitative methods, as well as having researchers with little to no association with the program being studied. In addition it will be important to study mentoring in terms of school context within a content specific mentoring program in order to fully understand the possible impact.

Though limitations do exist for this study, there is still much to be learned about supporting and mentoring elementary teachers in content and context specific ways. This study illuminated critical areas for future research in the mentoring of elementary teachers. One such area is determining components of an effective mentoring experience for practicing elementary school mathematics teachers. Another critical area is understanding the models of mentoring that are most effective for such teachers. And lastly, understanding the possible impact and incredibly personal experience that context has teacher's mentoring experiences.

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## APPENDIXES

## APPENDIX A

## TEACHING OBSERVATION TOOL

**Teaching Observation Tool**

**PART I. IN THE CLASSROOM.**

Observer: \_\_\_\_\_ Time Lesson Begins/Ends: \_\_\_\_\_/\_\_\_\_\_

Teacher: \_\_\_\_\_ Duration of lesson (h:mm): \_\_\_\_\_

School/Grade: \_\_\_\_\_ Text/Materials: \_\_\_\_\_

Observation Date/#: \_\_\_\_\_ Lesson Topic: \_\_\_\_\_

**BEFORE THE LESSON**

**A. Classroom Demographics/Lesson Context.**

1. Indicate the total number of *students* in the class at the time of the observation. \_\_\_\_\_

2. Indicate the number of *non-white students* in the class at the time of the observation. \_\_\_\_\_

3. What is the **primary** mathematical strand for this lesson?  
 Number  Geometry  Measurement  Algebra  Data Analysis  Probability  Other

4. Based on the lesson plan, what are the intended mathematical objectives for this lesson?  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

5. Description of materials available for students to use: \_\_\_\_\_  
 \_\_\_\_\_

6. Description of technology used by teacher and/or students: \_\_\_\_\_  
 \_\_\_\_\_

**DURING THE LESSON**  
 Use the line numbered Lesson Flow Recording Sheets provided for making detailed time-annotated field notes of the lesson. Use these notes to summarize the lesson and complete the remainder of this form.

Adapted from the University of Wisconsin Longitudinal/Cross-Sectional Study of the Impact of Mathematics in Context Classroom Observation Scale (1997), the Horizon Research Local Systemic Change Classroom Observation Protocol (2008), and the Silicon Valley Mathematics Initiative Mathematics Teaching Rubric (2007).

Page 1



**C. Classroom Events.** (For this section, refer to the Observation Scale Descriptors.)

1. The lesson provided opportunities for students to make conjectures about mathematical ideas.	1	2	3
2. The lesson fostered the development of conceptual understanding.	1	2	3
3. Connections within mathematics were explored in the lesson.	1	2	3
4. Connections between mathematics and students' daily lives were apparent in the lesson.	1	2	3
5. Students explained their responses or solution strategies.	1	2	3
6. Multiple perspectives/strategies were encouraged and valued.	1	2	3
7. The teacher valued students' mathematical statements and used them to build discussion or develop shared understanding.	1	2	3
8. The teacher used student inquiries as a guide for instructional decisions or to shape the mathematical content of the lesson.	Y	N	NA
9. The teacher encouraged students to reflect on the reasonableness of their responses.	1	2	3

**D. Additional Instructional Indicators.**

	Not at all		To a great extent			Don't know		N/A
	1	2	3	4	5	6	7	
1. The resources available during this lesson contributed to accomplishing the purposes of the lesson.	1	2	3	4	5	6	7	
2. Adequate time and structure were provided for <u>discourse</u> .	1	2	3	4	5	6	7	
3. The teacher's classroom management style/strategies enhanced the quality of the lesson.	1	2	3	4	5	6	7	
4. The teacher's questioning strategies were likely to enhance the development of student conceptual understanding/ problem solving (e.g., emphasized higher order questions, appropriately used <i>wait time</i> , identified prior conceptions and/or misconceptions).	1	2	3	4	5	6	7	
5. The mathematics content was significant and worthwhile.	1	2	3	4	5	6	7	
6. Teacher-provided content information was accurate.	1	2	3	4	5	6	7	
7. The degree of <i>sense-making</i> of mathematics content within this lesson was appropriate for the developmental levels/needs of the students and the purposes of the lesson.	1	2	3	4	5	6	7	

**E. Classroom Culture Indicators.**

	Not at all		++		To a great extent		Don't know	N/A
	1	2	3	4	5	6	7	
1. Active participation of all students was encouraged and valued.	1	2	3	4	5	6	7	
2. There was a climate of respect for students' ideas, questions, and contributions.	1	2	3	4	5	6	7	
3. Interactions among students reflected collegial working relationships (e.g., students worked together, talked with each other about the lesson).	1	2	3	4	5	6	7	
4. Interactions between teacher and students reflected collaborative working relationships.	1	2	3	4	5	6	7	
5. The climate of the lesson encouraged students to generate ideas, questions, conjectures, and/or propositions.	1	2	3	4	5	6	7	
6. Intellectual rigor, constructive criticism, and the challenging of ideas were evident.	1	2	3	4	5	6	7	

**F. Respect for Diversity.**

Based on the culture of a classroom, observers are generally able to make inferences about the extent to which there is an appreciation of diversity among students (e.g., their gender, race/ethnicity, and/or cultural background). While direct evidence that reflects particular sensitivity or insensitivity toward diversity is not often observed, please document any examples you see. If any examples were observed, please check here  and describe them below:

## APPENDIX B

## MENTORING FOR EFFECTIVE MATHEMATICS TEACHING (MEMT) SURVEY

**Mentoring for Effective Mathematics Teaching (MEMT) and Demographics Survey**

The following statements are concerned with your mentoring experiences in mathematics teaching during your last professional experience (internship). Please indicate the degree to which you agree or disagree with each statement below by circling only one response to the right of each statement.

**Key****SD** = Strongly Disagree**D** = Disagree**U** = Uncertain**A** = Agree**SA** = Strongly Agree**A. During my mentoring/internship experience in mathematics teaching, my mentor:**

1. was supportive of me for teaching mathematics. .... SD D U A SA
2. used mathematics language from the current mathematics syllabus. .... SD D U A SA
3. guided me with mathematics lesson preparation. .... SD D U A SA
4. discussed with me the school policies used for mathematics teaching. .... SD D U A SA
5. modeled mathematics teaching. .... SD D U A SA
6. assisted me with classroom management strategies for mathematics teaching. SD D U A SA
7. had a good rapport with the students learning mathematics. .... SD D U A SA
8. assisted me towards implementing mathematics teaching strategies. .... SD D U A SA
9. displayed enthusiasm when teaching mathematics. .... SD D U A SA
10. assisted me with timetabling my mathematics lessons. .... SD D U A SA
11. outlined state mathematics curriculum documents to me. .... SD D U A SA
12. modeled effective classroom management when teaching mathematics. SD D U A SA
13. discussed evaluation of my mathematics teaching. .... SD D U A SA
14. developed my strategies for teaching mathematics. .... SD D U A SA
15. was effective in teaching mathematics. .... SD D U A SA
16. provided oral feedback on my mathematics teaching. .... SD D U A SA
17. seemed comfortable in talking with me about mathematics teaching. .... SD D U A SA
18. discussed with me questioning skills for effective mathematics teaching. SD D U A SA
19. used hands-on materials for teaching mathematics. .... SD D U A SA
20. provided me with written feedback on my mathematics teaching. .... SD D U A SA
21. discussed with me the knowledge I needed for teaching mathematics. .... SD D U A SA
22. instilled positive attitudes in me towards teaching mathematics. .... SD D U A SA
23. assisted me to reflect on improving my mathematics teaching practices. SD D U A SA
24. gave me clear guidance for planning to teach mathematics. .... SD D U A SA
25. discussed with me the aims of mathematics teaching. .... SD D U A SA
26. made me feel more confident as a mathematics teacher. .... SD D U A SA
27. provided strategies for me to solve my mathematics teaching problems. ... SD D U A SA
28. reviewed my mathematics lesson plans before teaching mathematics. .... SD D U A SA
29. had well-designed mathematics activities for the students. .... SD D U A SA
30. gave me new viewpoints on teaching mathematics. .... SD D U A SA
31. listened to me attentively on mathematics teaching matters. .... SD D U A SA
32. showed me how to assess the students' learning of mathematics. .... SD D U A SA
33. clearly articulated what I needed to do to improve my mathematics teaching. SD D U A SA
34. observed me teach mathematics before providing feedback? .... SD D U A SA

APPENDIX C  
DEMOGRAPHICS SURVEY AND RESULTS

Please complete the following information:

1. Grade level you are now teaching:
  - K: 3(12%)
  - 1: 4(16%)
  - 2: 2(8%)
  - 3: 5(20%)
  - 4: 7(28%)
  - 5: 4(16%)
  
2. Gender:
  - F: 26(100%)
  - M: 0
  
3. Years of teaching experience at elementary level: 2.6 (mean) years
  
4. How would you describe your school *location*?
  - Rural: 3(12%)
  - Suburban: 15(57%)
  - Urban: 8(31%)
  
5. What is the estimated percentage of students at your school who receive free or reduced lunch?
  - 0-25%: 12(46%)
  - 26-50%: 3(11%)
  - 51-75%: 2(8%)
  - 76-100%: 9(35%)
  
6. What was the ethnicity of most of the students at that school?
  - Black: 10(38%)
  - White: 14 (54%)
  - Asian:
  - Hispanic: 2(8%)
  - Other:

## APPENDIX D

## INTERVIEW QUESTIONS

1. What are some personal characteristics of a mentor that you think are important for effective mentoring in mathematics? (personal attributes)
2. In relation to your mathematics teaching ability, how important was it that your mentor had an understanding of system requirements, such as school policies and curriculum in mathematics? (system requirements)
3. Was your mentor able to help build your pedagogical knowledge for mathematics? (pedagogical knowledge)
4. How important to you was it that your mentor model effective mathematics teaching? (modeling)
5. Describe the demographic make-up of the students at the school when you received mentoring in terms of ethnicity. (demographics)
6. Describe the demographic make-up of the students at the school when you received mentoring in terms of socio-economic status. (demographics)
7. Did your mentoring experience facilitate your ability to teach mathematics in ethnically diverse school contexts? If so, how so? (context)
8. Did your mentoring experience facilitate your ability to teach mathematics in high-poverty school contexts? If so, how so? (context)
9. What was the adopted mathematics curriculum at your school? (curriculum)
10. What were the school's expectations about teaching mathematics? i.e. what were the expectations around what mathematics teaching should look like at your school? (school culture for teaching mathematics)
11. Were the practices and expectations of the mentoring experience aligned with the practices and expectations of teaching mathematics at your school? (alignment of expectations)