PRESCHOOL CAREGIVERS' MATHEMATICAL ANXIETY: EXAMINING THE RELATIONSHIPS BETWEEN MATHEMATICAL ANXIETY, AND KNOWLEDGE AND BELIEFS ABOUT MATHEMATICS FOR YOUNG CHILDREN

A DISSERTATION

SUMBITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

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To the Dean of the Graduate School:

I am submitting herewith a dissertation written by Gail J. Cox entitled "Preschool Caregivers' Mathematical Anxiety: Examining the Relationships Between Mathematical Anxiety, and Knowledge and Beliefs About Mathematics for Young Children." I have examined this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy with a major in Child Development.

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DEDICATION

To my husband, Lonnie Cox for being a super-husband, allowing me to be me! Who loved, supported and encouraged me every inch/step and mile of the educational journey and to our wonderful life.

To my children, Stacy and Jason and their families for listening and being there to encourage me along the way and continued their educations at the same time.

To my wonderful grandchildren, Zackery and Mikayla and all the love and hugs they shared.

To Early Childhood Caregivers in Texas, you do make a difference!

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ABSTRACT

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PRESCHOOL CAREGIVERS' MATHEMATICAL ANXIETY: EXAMINING THE RELATIONSHIPS BETWEEN MATHEMATICAL ANXIETY, AND KNOWLEDGE AND BELIEFS ABOUT MATHEMATICS FOR YOUNG CHILDREN

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The purpose of this descriptive, quantitative approach study was to identify dimensions of mathematical anxiety as well as knowledge and beliefs related to children's mathematical development and the curriculum in preschool classrooms. The mathematical anxiety scores were correlated with levels of knowledge and beliefs about mathematics for young children. Preschool caregivers in Bell and Coryell counties in Central Texas were asked to complete the four part survey. The survey tools used were: Mathematics Anxiety Scale—Revised instrument; Knowledge of Mathematical Development Survey; Beliefs about Mathematics Teaching and Learning in the Preschool Classroom Survey, and a demographic questionnaire. Of the fully licensed child care centers, 36% agreed to allow their preschool caregivers to complete the survey. The survey was completed by 207 individuals. This was a 76% return rate of the surveys.

Mathematical Anxiety resulted in identification of three domains- High Positive Affect; High Negative Affect and Mixed Affect. The Knowledge of Mathematical Development scores showed that caregivers identified the correct sequence of math development in 55% of the items. Beliefs about Mathematics Teaching and Learning in the Preschool Classroom was a 40 statement survey. Caregivers strongly agreed that

mathematics were age appropriate and important goals for preschool curriculum. They believed they were knowledgeable and comfortable with teaching math and believed that the teacher should play a central role in teaching mathematics in preschool.

The correlations of Knowledge and Beliefs had significant interaction in a positive way when comparing the Beliefs of Age-Appropriateness, Goals about Math in the Classroom, Comfort Level of Teaching Mathematics, and negative correlation with Locus of Generation of Mathematical Knowledge subscale. When comparisons of Knowledge and Math Anxiety groups were examined the Math Anxiety scores did not differ significantly when knowledge of children's mathematical development was measured. Those in the High Positive Affect group tended to have the highest number of correct responses on the Knowledge survey while the Mixed Affect group scored lowest number of correct responses. The Math Anxiety subscales tended to follow the pattern that the High Positive Affect group scored highest on the Beliefs, followed by the Mixed Affect group. The High Negative Affect group scored the lowest on the three Beliefs subscales. High Positive and High Negative were most dissimilar.

Results of this study have implication for professional development, college professors, center directors, caregivers and children. Recommendations for future research were addressed.

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CHAPTER I

INTRODUCTION

Preschool caregivers create the environment for young children ages three to five years old to explore and discover. Jean Piaget (1965) wrote that children construct their own understanding and that they have inherent desire for finding patterns and solving problems. Research found that many teachers recall their own negative feelings about math and this may be translated into their creation of math activities for preschool children (Hachey, 2009).

Preschool caregivers who have knowledge, skills, and experience in child care may have a better understanding how to support preschool children's learning experiences. The publication *Developmentally Appropriate Practice in Early Childhood Programs: Serving Children from Birth through Age 8*, by the National Association for the Education of Young Children (NAEYC) recognized that teachers' knowledge and decision making are vital to educational effectiveness (Copple & Bredekamp, 2009). Math experiences may be a challenge to preschool caregivers because of their own anxiety and memories of negative experiences (Hachey, 2009).

Mattel Toys created Teen Talk Barbie® doll in 1992. One of the pre-programmed statements in Barbie said "math class is tough" (Washington Post, 1992). The American Association of University Women provided a statement that the Barbie doll quip perpetuated a sexist stereotype, that could be damaging to young girls' self-esteem (PRN newswire, 1992). Barbie's words emphasized the gender bias that portrays girls as less

skilled at math. This example of stereotyping may affect preschool caregivers, because most caregivers are female (Beilock, Gunderson, Levine, & Ramirez, 2010). The stereotype can also affect caregivers' perception of what they can do.

Statement of Problem

Jackson and Leffingwell (1999) reported that many early childhood teachers, stuck with their negative math mindset, do not approach mathematics instruction in a natural and inquisitive manner. This is a problem because young children tend to internalize their teachers' enthusiasm or lack of. College students majoring in Child Development talk about how hard math is for them and that they are unsure about what to do when working with young children (Hachey, 2009). Many preschool caregivers provide worksheets and have children rote count as their math experiences, similar to ways they experienced math in elementary school (Hachey, 2009). Young children learn by doing, talking, reflecting, discussing, observing, investigating, listening, and reasoning. To learn mathematics, children must be actively involved in mathematics content (Copley, 2010). Mathematics anxiety in teachers may serve to foster early development of mathematics anxiety in their students (Vinson, 2001).

Currently enrolled Child Development students have said they avoid taking any math classes until the very end of their degree program and may consider not finishing their degree because of the core math requirements. During the June 2010, course review workshop sponsored by Texas Workforce Education Course Manual (WECM) in Midland, Texas a conversation between Child Development Department Chairs discussed Child Development students' reluctance to take child development math courses.

Students told instructors that they were not good at math and did not want to take the course. Department chairs also discussed how to support the students' reluctance to take the developmental and core math class to fulfill the degree requirements.

Justification for Study

Evidence from research suggests that children get many of their clues about behaviors and values from their caregivers and that modeling is a very important part of early childhood learning (Copple & Bredekamp, 2009; Hachey, 2009). National Association for the Education of Young Children (NAEYC) and the National Council of Teachers of Mathematics (NCTM) Principles and Standards in School Mathematics includes standards for grades pre-K through second grade (NAEYC & NCTM, Early Childhood Mathematics: Promoting Good Beginnings, 2002). The standard explains that preschool caregivers should begin by discovering what young children already understand and then helping them begin to understand new concepts (NAEYC & NCTM, Early Childhood Mathematics: Promoting Good Beginnings, 2002). Caregivers need to support children's experiences and relate the children's knowledge to the vocabulary and conceptual frameworks for mathematics (NAEYC & NCTM, Early Childhood Mathematics: Promoting Good Beginnings, 2002).

Preschool caregivers who struggle with their own anxieties about mathematics may not recognize opportunities to enrich children's innate desire to experience mathematics on a daily basis. Caregivers need to put aside their bad memories and anxieties to notice, value, and build on children's excitement as they explore mathematics from the earliest ages (Feikes & Elsenhauer, 2009).

There is a lack of published research identifying math anxiety in preschool caregivers. Many studies have focused on pre-service elementary school teachers (Jackson & Leffingwell, 1999; Tobias, 1993; Vinson, 2001). This study was designed to investigate the math anxiety of preschool caregivers and their knowledge of mathematical development and beliefs about math for preschool children.

Statement of Purpose

This study was designed to describe preschool caregivers' math anxiety and their knowledge of mathematical development and beliefs about mathematics curriculum for young children. The study focused on college students majoring in Child Development; all participants were employed 15 hours or more a week in a child development program as preschool caregivers in Bell and Coryell counties in Texas.

Research Questions

The following are research questions.

1. What are the dimensions of mathematical anxiety expressed by preschool caregivers?
2. What do preschool caregivers know about early mathematical development?
3. What are preschool caregivers' beliefs about mathematics teaching and learning in the preschool classroom?
4. Are there correlations between Knowledge of Mathematical Development (KMD) and Beliefs about Mathematics Teaching and Learning in the Preschool Classroom?

5. Are there differences in mean Knowledge of Mathematical Development (KMD) scores when caregivers are grouped by Math Anxiety Scale-Revised (MAS-R) scores?
6. Are there differences in the four Beliefs about Mathematics Teaching and Learning in the Preschool Classroom subscales scores when caregivers are grouped by Math Anxiety Scale-Revised (MAS-R) scores?

Definitions

Preschool children are children ages three to five years old (Copple & Bredekamp, 2009).

Math anxiety has been characterized in many ways, such as an uneasiness when conducting everyday mathematical activities, leaving math courses to the very end of degree programs, feeling ill, dread, or panic when ask to do math activities, a feeling that nothing will help improve math skills (Smith, 1997). For the purposes of this study Mathematical Anxiety Scale - Revised (MAS-R) will be operationally defined as the scores obtained on the MAS-R (Bai, 2010).

Child Development students are students enrolled at either Central Texas College in Killeen, Texas or Temple College in Temple, Texas in the Child Development Departments and who are currently employed 15 hours or more per week as preschool caregivers.

Preschool caregivers are currently employed classroom teachers working 15 hours or more per week in local child care centers in Bell and Coryell counties, in Texas.

Delimitations

Participants in the study were Child Development students and preschool caregivers. Child Development students were currently enrolled in Child Development courses in community colleges in Bell and Coryell County, Texas in the fall of 2010 and employed 15 hours or more as preschool caregivers in full permit licensed child care programs in Bell or Coryell County. Preschool caregivers were also eligible if employed at Fort Hood Military Base's four military childcare centers which are located in Bell County. The military programs were not state licensed but federally operated under AR 608.10 Army Regulation. The military centers were all National Association for the Education of Young Children (NAEYC) accredited. NAEYC accreditation is a national voluntary program that has set professional standards for early childhood education programs, and helps families identify high-quality programs for their young children (Collaborations with Promising Early Childhood Initiatives, 2010).

Limitations

The following were potential weaknesses of the study

1. The study setting was limited to two counties in Central Texas
2. The study involved currently employed caregivers.
3. The Knowledge of Mathematical Development (KMD) survey focused on number and operations, only one of the components of math.
4. Participants who choose to participate may be different from those who choose not to participate.

Summary

This chapter identified the problem and explained the purpose for the study involving preschool caregivers and their dimensions of math anxiety. The study was designed to describe math anxiety, knowledge of mathematical development, and mathematical curriculum beliefs about math for preschool children. Child development students and preschool caregivers from two counties in Texas were surveyed to investigate this issue.

Preschool children are exploring and gathering information about their world through play, observation, and intentionally created activities. Caregivers have a great responsibly for the children in their care. The results of this study may be used to support those caregivers as they develop a better understanding about their personal mathematical anxiety and knowledge of children's development.

CHAPTER II

REVIEW OF LITERATURE

Early childhood caregivers need to create environments that support young children in their opportunities to explore (Copple & Bredekamp, 2009). Early childhood caregivers should know more about mathematics and how to implement math experiences for young children (Ginsburg & Golbeck, 2004). Hachey (2009) suggested that many caregivers recall from early experiences their own negative feelings about math and this may inhibit their ability to develop engaging math curriculum. The scope of literature review of early childhood preschool programs includes opportunities for young children to explore and develop a broader understanding of the world around them (Copple & Bredekamp, 2009; Copley, 2010; Ginsburg & Golbeck, 2004; Sarama, DiBiase, Clements, & Spitler, 2004). Among practitioners in the field there is recognition that teachers' perceptions and anxieties (Clements & Sarama, 2004) impact the development of math experiences in their classrooms (Copley, 2010; Ginsburg & Golbeck, 2004; Sarama et al., 2004).

Concerns about Mathematics in Early Childhood Programs

Math anxiety has been an area of study for many years. Pre-service teachers' math anxiety transfers to the students in their elementary classrooms (Gates, 2002; Jackson & Leffingwell, 1999; Kelly & Tomhave, 1985; Martinez, 1987; Vinson, 2001; Wood, 1988). Students follow the communications of their teachers and they model what their teachers portray as they learn mathematics in elementary school (Akinsola, 2008). A

study of 122 in-service teachers enrolled in a degree program examined mathematics anxiety, mathematics testing efficacy beliefs, locus of control, study habits and problem solving abilities. An important finding was that teachers' attitudes about mathematics were not eparated from their process of learning about math. Positive problem-solving skills scores were higher for the teachers who had lower levels of mathematics anxiety, math efficacy beliefs, and locus of control (Akinsola, 2008).

Preschool caregivers come to work with concepts and values based on their own experiences. Recommendations for developmentally appropriate practices from the National Association for the Education of Young Child (NAEYC) directed that caregivers recognize and consider their values when working with young children (Copple & Bredekamp, 2009). Many caregivers remember being taught mathematics in an environment filled with tension and frustrations. These feelings of math anxiety continue in adulthood (Hachey, 2009). The caregivers' anxieties when teaching math often results in following the pattern of rote tasks, memorization, flashcards and daily homework which continues the vicious cycle (Gierl & Bisanz, 1995).

Mathematics anxiety has roots in teaching and teachers (Tobias, 1993; Vinson, 2001). Some teachers feel that their mathematic anxiety could have been prevented in elementary school, if they had received instruction of mathematical concepts through the use of concrete manipulatives (Gresham, 2007). Mathematics anxiety has an effect on learning and may have an effect on school curricula and teaching math in the classroom (Gresham, 2007). This is cause for concern when considering how teachers may transfer their negative feeling to students. Math anxiety of the caregiver is a concern. A Beilock,

Gunderson, Levine, and Ramirez (2010) study found that if the teachers of math in the classroom have math anxiety, that anxiety can be transferred to the students. Beilock reported, "If people who are anxious about math are charged with teaching others mathematics—as often the case of elementary school teachers—teachers' anxieties can have consequences for their students' math achievement" (Beilock et al., 2010, p. 2).

The foundation for math is laid while children are young (Philippou & Christou, 1998). Young children play with math as they interact daily. Caregivers who support and encourage that learning are very important. Young children tend to internalize the attitudes of their caregivers (Jackson & Leffingwell, 1999). According to Piaget's theory, young children continually construct mathematical concepts based on their experience by practicing with what they know and experimenting with new ideas and concepts (Piaget, 1965).

Copley (2010) addressed the issue of the need for child caregivers to provide quality math experiences for preschool children to build a positive foundation in mathematics. The National Council of Teachers of Mathematics (NCTM) along with The National Association for the Education of Young Children (NAEYC) in their joint position statement on Early Childhood Mathematics recognized that caregivers are pivotal in creating an environment so that children can be successful in mathematics (NAEYC & NCTM, Early Childhood Mathematics: Promoting Good Beginnings, 2002). Caregivers have many requirements to ensure that a quality early childhood mathematical program are available to children. Caregivers should understand young children's cognitive, physical, social, emotional and language development in order to enhance

children's interests built on prior experiences and knowledge and strengthen children's problem solving skills. The mathematics curriculum needs to be planned according to the development of children's understanding of relationships and sequences in mathematics. The implementation of curriculum should include time, materials, support, and ongoing assessment of mathematical skills (NAEYC & NCTM, Early Childhood Mathematics: Promoting Good Beginnings, 2002).

Young children are motivated to use mathematical skills. The caregiver is to model the joy of learning tasks and to reinforce the experiences rather than focusing on the correct answers (Copley, 2010). A caregivers' support is necessary to help children make the connection between informal mathematics and formal mathematical learning (Clements & Sarama, 2004; Epstein, 2007). An example of informal mathematics for young children is that children will give each person one plate when helping set the table at dinner, for one-to-one correspondence. The addition of instructions to the child to place two cookies on each plate by giving every person one cookie and then one more can change this same activity into a formal mathematical experience with the support of intentional teaching. This connection happens when children use their informal knowledge to structure information and solve problems (Copley, 2010; Smith, 2009).

The caregiver's role is to provide a setting that is designed to allow preschool children to solve problems. Caregivers should equip their classrooms to support preschool children's exploration and experimentation with many math concepts (Copley, 2010). Making activities relevant to children is essential to encourage children to participate in activities (Copple & Bredekamp, 2009). Caregivers can support children's

learning by introducing vocabularies that encourage conversations about mathematics (Copley, 2010).

Another critical aspect of curriculum is intentional planning by the caregiver. Intentional planning requires that caregivers have an understanding of the preschool child's developmental levels as well as an easy command of mathematical concepts. Activities that are planned with particular math skills in mind should be introduced to the children as part of the ongoing curriculum goals. For example, Copley (2010) explained that algebraic thinking is taught to young children when they pattern and use symbols to represent problems and the solutions. An example of patterning is children who clap to a series of claps and then repeat that series. This includes recognizing, hearing and repeating a pattern, as in the song [B-I-N-G-O].

Standards

The mathematics curriculum in Texas, for young children incorporates multiple sets of standards. Developmentally Appropriate Practices from The National Association for the Education of Young Children (NAEYC), The National Teachers of Mathematics (NCTM), and Revised Texas Pre-kindergarten Guidelines (2008) provide principles and parameters for the implementation of mathematics curriculum for preschool children. The NCTM and NAEYC joint position statement proposed that math is for everyone and that math shapes children's future. All children should have opportunities to learn mathematics with depth and understanding (National Council for Teachers of Mathematics, 2002). Teachers of mathematics can best promote young children's thinking and learning about math when they talk with them and discuss ways to solve

problems. Helping children make the connections between their lives and mathematics enhances learning (Copple & Bredekamp, 2009; Revised Texas Pre-Kindergarten Guidelines, 2008).

Caregivers should include mathematics in their curriculum by offering opportunities for young children to develop vocabulary and concepts about math in children's everyday lives (Copple & Bredekamp, 2009; Epstein, 2007; Revised Texas Pre-Kindergarten Guidelines, 2008). Activities that are teacher-directed should be connected with children's current knowledge. Caregivers create environments that encourage young children to take risks and develop problem solving skills (Copple & Bredekamp, 2009). Developmentally Appropriate Practices (2009) recognizes that a challenge for preschool caregivers is the need to provide a rich mix of challenge, support and stimulation to promote children's' growth. The foundation of this learning is a nurturing relationship between caregivers and children. The role of the caregiver in helping children develop mathematical skills by asking well timed questions that encourage future exploration. Quality mathematical activities also develop language and vocabulary skills. An example is a caregiver that transitions children from story to lunch by directing the children wearing blue may go to snack first, the children wearing red may go second and then at the end children wearing pink are the last to go to snack (Copple & Bredekamp, 2009).

Copple and Bredekamp (2009) in *Developmentally Appropriate Practices: Serving Children from Birth Through Age 8* provide a section that defined appropriate consideration in practices. Caregivers in mathematics develop positive practices by

recognizing children's interests and helping children see math in everyday encounters. As the children play caregivers help them understand opportunities to experience math and math concepts, the caregiver is instrumental in integrating math learning experiences throughout the day. Caregivers engage children by promoting reasoning and problem solving in everyday situations. The summary of what the caregiver does to support mathematical development is "Teachers actively foster children's understanding of whole numbers (including counting, one-to-one correspondence, and number relationships) and of beginning operations (joining and separating sets). They engage children in thinking about and working with geometric/spatial relationships and manipulating two-dimensional and three-dimensional shapes (Copple & Bredekamp, 2009, p. 172). *Developmentally Appropriate Practices* also recognizes that many preschool caregivers are not knowledgeable in mathematics concepts, and sequences of learning. This makes in hard for the caregivers to develop effective strategies and curriculum.

Revised Texas Pre-kindergarten Guidelines (2008) expanded concepts about activities to develop children's math skills, major concepts where defined and ideas for caregivers to develop activities and assess outcomes were defined. The chart indicated that children by the age of 48 months would have mastered the skills. The counting skills provided ideas about position counting; first, second, third along with the child recognizing one-to-one correspondence. Consideration of the adding and taking away concept was supported by activities that created verbal problems and children could use fingers to add or reduce sets. Geometry and spatial sense skills identified shapes and put them together to create objects. Measurement skills used measurement words to describe

things as tall, short, thin, wide. Blocks environments were encouraged as an everyday area that children could practice the verbal and cognitive skills of understand these concepts. Classification and pattern skills were when children recognized patterns in their environment and could create patterns within activities. Children were encouraged to sort and categorize items related to color, shape, size and other properties the child found (Revised Texas Pre-Kindergarten Guidelines, 2008). The guidelines are designed to help connect the early childhood activities and the elementary activities to support children's learning of math skills in a sequential manner to help children continue to develop and build mathematical knowledge.

NCTM and NAEYC joint position statement reflects what Developmentally Appropriate Practices and the Revised Prekindergarten Guidelines propose with specific recommendations listed in the Executive Summary.

"In high-quality mathematics education for three-to-six-year-old children, teachers and other key professionals should

- Enhance children's natural interest in mathematics and their disposition to use it to make sense of their physical and social worlds;
- Build on children's varying experiences, including their family, linguistic, and cultural backgrounds; their individual approaches to learning; and their informal knowledge;
- Base mathematics curriculum and teaching practices on current knowledge of young children's cognitive, linguistic, physical and social;-emotional development;

- Use curriculum and teaching practices that strengthen children's problem-solving and reasoning processes as well as representing, communicating, and connecting mathematical ideas;
- Ensure that the curriculum is coherent and compatible with known relationships and sequences of important mathematical ideas;
- Provide for children's deep and sustained interaction with key mathematical ideas;
- Integrate mathematics with other activities and other activities with mathematics;
- Provide ample time, materials, and teacher support for children to engage in play, a context in which they explore and manipulate mathematical ideas with keen interest;
- Actively introduce mathematical concepts, methods, and language through a range of appropriate experiences and teaching strategies; and
- Support children's learning by thoughtfully and continually assessing all children's mathematical knowledge, skills, and strategies.

To support high-quality mathematics education, institutions, program developers, and policymakers should

- Create more effective early childhood teacher preparation and continuing professional development in mathematics;
- Use collaborative processes to develop well-aligned systems of appropriate, high-quality standards, mathematics curriculum, and assessment;

- Design institutional structures and policies that support teachers' mathematics learning, teamwork, and planning; and
- Provide resources necessary to overcome the barriers to young children's mathematical proficiency at the classroom, community, institutional and system-wide levels" (NAEYC & NCTM, Executive Summary, 2002, p. 1).

As the awareness of the importance of early childhood mathematics learning increased the knowledge about the base math learning has also expanded. Caregivers are ready to provide appropriate experiences for young children. It is now time for education, policies and the community to make the commitment to provide the resources and training to energize caregivers and early childhood programs (NAEYC & NCTM, Executive Summary, 2002).

Caregivers support mathematical learning by creating opportunities for young children to use mathematical vocabulary within classroom activities that are relevant and meaningful to the children (Gronlund, 2006; Revised Texas Pre-Kindergarten Guidelines, 2008). Math is not a specific part or section of the classroom but rather throughtout the environment and within the play and other activities as informal opportunites to expereince mathematical skills during the day. Caregivers observe and know individual learner's developmental levels to design meaningful experiences using concrete materials (Revised Texas Pre-Kindergarten Guidelines, 2008). An intentional caregiver has many strategies to help support young children's mathematical learning. The caregivers surround the children with a number rich environments, take advantage of situations to encourage mathematical vocabulary and problem solving, provide thoughtful opportnities

for the children to explore and develop math ideas using hands-on materials. The caregiver is also responsible to ensure that observations are used to identify strengths and opportunities to support the children's curiosity and as they become aware of uniqueness in their environments (Epstein, 2007).

Mathematics curriculum is one of the content areas that has received limited attention in the recent past (Copple & Bredekamp, 2009; National Council for Teachers of Mathematics, 2002). Developmentally appropriate practices identifies that quality caregivers across the curriculum need to use their knowledge and skills to enhance the way they encourage and develop young children's understanding of cognitive and social skills. Guidelines for quality caregivers include opportunities to engage young children, plan to support goals, observe and evaluate young children's development and learning. Create appropriate experiences based on children development and understand and develop a relationship with families that recognizes the family diversity and encourages communication and trust (Copple & Bredekamp, 2009). These qualities support the development of the whole child as they navigate through the early learning years, caregivers must be knowledgable and skilled to support the learning process (Epstein, 2007).

Reluctance to Enroll in Math Classes

Large numbers of college students are enrolled in developmental math classes. Math anxiety is evident by students' continual struggle to be successful (Hagedorn, Lester, & Cypers, 2010). Math anxiety may include students' preoccupation with the fear and dislike of math which may hinder performance of math problems because they are

distracted by their fears (Ashcraft, 2002). High school and college students that demonstrate high math anxiety are less likely to enroll in additional and extra math classes. The students receive lower grades and have a negative attitude about math (Ashcraft, 2002).

An alarming number of college-bound students across the country are unable to do grade-level math. "The consistent feedback from colleges has been that students are not well prepared to do college-level work," said Tom Horgan, president of the New Hampshire College & University Council (Woodburn, 2010, p. 1). Nationally, 60 percent of all students at two-year colleges are required to take developmental math classes. Community colleges have higher remediation numbers because typically the student population is adult learners, many of whom have not taken a math class in a decade or more (Woodburn, 2010).

The two year colleges, in Bell and Coryell Counties in Texas, require that all degree programs include at least one math course. Early childhood degrees across Texas require at least one math based course. Degrees that lead to teacher certification require four math based courses. Temple College reported that 1187 of the 5599 students were enrolled in developmental math courses for spring 2010. Of the total female college enrollment 22% (820) were taking developmental math classes. Of the total male college enrollment 19% (367) were taking developmental math classes. Of developmental math students enrolled for the spring 2010 semester the break down by gender was 69% female and 31% male (Temple College, Temple, Texas, Office of Institutional Effectiveness, Research, and Planning, 2010; [Spring 2010 Developmental Mathematics Enrollment]

Unpublished raw data). The enrollment of Central Texas College indicated that 1,218 of the 6,210 students were enrolled in developmental math courses for spring 2010. Of the total female college enrollment 22% (855) were taking developmental math classes. Of the total male college enrollment 16% (363) were taking developmental math classes. Of developmental math students enrolled for the spring 2010 semester the break down by gender was 70% female and 30% male (Central Texas College, Killeen, Texas, Office of Institutional Effectiveness, 2010; [Spring 2010 Developmental Mathematics Enrollment] Unpublished raw data).

Studies of Math Anxiety

Teacher's feelings of math anxiety can cover a wide range of concerns from a lack of confidence in the ability to use mathematics correctly, to beliefs that teaching math is not supported by appropriate practice, and a lack of interest in the teaching of mathematics at all (Harper & Danne, 1998).

Different types of mathematical methods courses in early childhood/elementary were studied by Gresham to evaluate if math anxiety could be reduced (Gresham, 2007). A study sample included of 246 junior early childhood/elementary education pre-service teachers working toward a K-6 endorsement from a large southeastern university enrolled in a mathematics methods course. The participants were given the Mathematics Anxiety Rating Scale (MARS) on the first day of the class and then as a post test at the end of the 12 week courses. Comments from the pre-service teachers' indicated that math concepts were more understandable, and they felt less stress after they had more information. The

most telling statement indicated that their math anxiety could have been less if they had received instruction using manipulatives in their elementary education (Gresham, 2007).

Austin and associates examined math anxiety in 50 pre-service and 15 in-service elementary teachers (Austin, Wadlington, & Bitner, 1992). Three tools were used; the Mathematics Anxiety Rating Scale (MARS), The Kulm Mathematics Self-Concept Test (KMSCT) and Math Belief Survey Instrument (MBSI).

The subjects were grouped according the 13 stems of the Math Beliefs Survey Instrument. A majority of the participants did not agree that men are better and did not agree that teaching took less math classes (Austin, Wadlington, & Bitner, 1992). The authors recommend future studies investigating math anxiety and math beliefs.

A study conducted by Isiksal (2009) involved 276 Turkish and 234 American early childhood and elementary school pre-service teachers who were primarily female, junior and senior college students. Groups in both countries had completed one teacher methods course in mathematics in addition to basic mathematics level courses. The tools used were an Abbreviated Math Anxiety Scale (AMAS) and Experience with Mathematics Questionnaire both were translated into Turkish. The results found that American pre-service teachers evidenced higher math anxiety while the Turkish pre-service displayed higher math self-concepts (Isikal, Curran, Koc, & Askum, 2009).

The difference in the educational systems it was found that regardless of the years in college, pre-service teachers in America had higher math anxiety. The author did not describe the different educational systems but referred to the differences in the way students were accepted into college programs. The required entrance exams in America

did not carry much weight in math. On the other hand in the Turkish education system there is a competitive process for college entrance. Therefore potential students have received many private lessons or tutoring before taking the college entrance exams (Isikal et al., 2009). One possible explanation for the lower math anxiety scores and higher math self-concept scores among Turkish pre-service students may be the extensive preparation for the university entrance exams (Isikal et al., 2009). The author recommended that future studies examine specific environmental and personality-related factors affect pre-service teachers' math-concept and math anxiety.

Gender Issues

Many caregivers are female and females are more likely to have math anxiety. Jackson and Leffingwell (1999) observed that gender bias was reported to show that girls received more ridicule and less assistance during math courses. Teachers were described as being uncaring and insensitive, that they did not explain and answer questions. The study examined students in elementary and secondary schools.

A study was conducted by Beilock and colleagues in 2010 to determine whether female early elementary teacher math anxiety affects their first and second grade students. The sample included 17 first and second grade female teachers in a large midwestern urban school district and 52 boys and 65 girls in their classrooms. Teachers' math anxiety was assessed using the short Math Anxiety Rating Scale. The Elementary Number Concepts and Operations subtest of the Content Knowledge for Teaching Mathematics measured teachers' math knowledge. The children's math beliefs and academic success were assessed. The students were given achievement assessments in the

first three months and then again two month before the end of the school year. Children were also read two gender neutral stories at the beginning and end of the year about a child that was good at math and one that was good at reading. Children were then asked to draw pictures of the child in the story. The drawings were scored based on portrayals of the commonly held belief that boys were good at math and girls were good at reading (Beilock et al., 2010).

Regression analyses were used to determine the effects of the teachers' math anxiety and math knowledge on the children's math achievement and endorsement of gender stereotypes. Teachers' math anxiety was negatively correlated with girls' math achievement but not with that of boys. Teachers' math knowledge was not found to be a significant predictor of children's outcomes.

The findings supported the hypothesis that girl students were affected by the math anxiety of female first and second grade teachers. Boys did not seem to be affected by the teachers' math anxiety. In addition, girls with lower math achievement also evidenced more stereotyped gender views, following the general held belief that girls are good at reading and boys are good at math. The author recommended that strong math skills and positive math attitudes should be promoted through teacher education programs (Beilock et al., 2010).

Teachers Lack of Knowledge and Training in Mathematics Curriculum

Young children continually construct mathematical ideas based on their experiences with their environments, their interactions with adults and other children, and their daily observations. These ideas are unique to each child and vary greatly among

children the same age (Copley, 2010; Copple & Bredekamp, 2009). When considering pre-service teachers developing a passion about caring for children it is important for the teachers to understand that they are to be an active part of the children's learning (Nowak-Fabrykowski & Caldwell, 2002). The teacher is part of this community atmosphere responsible for engaging children in learning (Copple & Bredekamp, 2009). Researchers have begun to recognize the relationship between quality mathematical instruction in preschool and the caregiver's beliefs about mathematical instruction in the classroom (Balfanz, 1999).

Curriculum Ideas for Enriching Mathematical Experiences for Young Children

Young children understand mathematics prior to formal schooling (Baroody, 2000; Charlesworth, 2005; Graham, Nash, & Kim, 1997; Sarama & Clements, The Mathematical Lives of Young Children, 2010). Graham and colleagues found in a literature review that "children's exposure to mathematics has been relatively overlooked in the research literature. Given children's difficulties in acquiring school mathematics skills and applying them to real world problems it seems important to explore how children's early understanding of mathematics develops and to focus on the context in which it develops to understand its structure." (Graham et al., 1997, p. 34).

Graham (1997) conducted research on two centers in small to mid-size cities. The centers served professional or of middle class backgrounds. One program is full day program of professional middle class families serving children in age specific groups and in a university-affiliated part-day program grouping children in combined three to five year old groups. Six hours of observations per classroom were done over a three week

period of time and with additional opportunities for teacher interviews. The interview included teacher's background, beliefs about function of preschool education, and attitudes about teaching mathematics. Ratio and hours of care and age groups of children were felt to be issues that may affect the type of classroom management that was observed.

Graham's 1997 research indicated through observations and information from teachers' some concepts that could be used to support children's future understanding of mathematics. The observations included songs/rhyme, direct teaching, opportunistic teaching and spontaneous unplanned interactions. The observations found teachers in the study emphatically believed informal teaching was superior to formal teaching. Teachers need to have planned and organized activities. Teachers indicated that they played informal games with concrete objects, even though little evidence of this was seen. When asked how to prepare the children for school the teachers all said, "Make math fun!" including the use of hands-on materials (Graham et al., 1997, p. 37). Teachers thought that it was somewhat important for three year olds to count to 10 but very important for four and five-year-olds to count to ten.

Klibanoff, Levine, Huttenlocher, Hedges, and Vasilyeva (2006), conducted a study with 26 classrooms from 13 preschools centers in Chicago area. This research was part of a larger project with both half and full day programs. A total of 198 children were observed, not all children in each classroom received permission from parents to participate. Teachers were observed in classroom visits from 2.5 to 3 hours in January or February. The researchers audio taped twenty-six lead teachers verbal output during class

time. The conversations were then transcribed and coded for math input. The taped conversation and the results of a questionnaire based on the NAEYC checklist for preschools consisting of ten questions that assess the general quality of teaching were evaluated. Children participating in the program were assessed with a 15 item assessment during a preschool day in a quiet place taking about ten minutes. The children's assessments were done at the beginning and end of year (October and April), 146 children completed both sets of assessments. The schools family population consisted of the three socioeconomic status groups (SES) low, middle, and high. The SES groups were identified using census tract data; the directors provided verification of income levels and parental educational levels. This research focused on math talk rather than a type of interventions.

Klibanoff et al. (2006) found that developmental studies indicate that early quantitative representations of math language were linked to quantitative language, notably, to knowledge of the count word. The first finding in the study was that the level of mathematical knowledge was higher for children from high-and middle-SES backgrounds than for children from low-SES backgrounds. The second finding was that the amount of math talk varied dramatically in amounts by preschool teachers. The third finding was the most significant, was that the amount of preschool teachers' math talk was significantly related to the growth of young children's conventional math knowledge over the course of the school year (Klibanoff et al., 2006). The findings resulted in the researchers noticing that the amount of preschool teacher input was significantly correlated with the average level of math growth in classrooms, that the amount of input

provided did not significantly differ across classrooms serving children from different SES groups, and that input that helps children learn the language of mathematics also affects their mathematical skills.

The message that more talk about math may have the potential to increase children's math skills is a simple one but one that holds promise for increasing the preparedness of large numbers of young children for the challenges they will face in elementary school and beyond (Klibanoff et al., 2006). Concepts for future consideration involved whether particular types of math input will more strongly predict the growth of specific types of math skills or overall growth of children's math knowledge.

Charlesworth (2005) reviewed the National Council of Teacher of Mathematics, (2000) for Prekindergarten Mathematics. NCTM's main math concepts are one-to-one correspondence, number and counting, shape, spatial sense, logical classification, comparing and parts and wholes. Children acquire concepts through three types of learning experiences: naturalistic, informal and structured.

The preschool period, ages three to five year olds, should have a major focus on naturalistic and informal instruction in mathematics. The connection between language and literacy is important for concept development. Seo (2003) emphasizes the importance of observation of mathematical related play allowing the caregiver to intervene at an opportune time and to help plan for structured experience. The ability for preschool teachers to provide informal scaffolding through questions and comments is how they help children to focus on naturalistic explorations on math (Charlesworth, 2005).

Recognition and understanding of children's developmental skill at the initial level is important as planned and unplanned math interactions are developed.

Baroody (2000) did research on children's number and arithmetic skills. The finding showed that three-year-olds are at the beginning levels of discriminating between groups of two and three items. The three and one-half to four year olds were able to compare the amounts in groups using their counting skills. While older preschoolers can solve concrete addition and subtraction problems, grasp of part-whole relationships, and equal. Caregivers building on the child knowledge by being positive, encourage, and provide experiences. Teachers should build on everyday exploratory activities, on responses to children's questions and providing mathematics games, and literature experiences.

Early childhood mathematical education should be implemented wide spread scale. The use of blocks, manipulatives and language were part of the essential components of the teacher's processes. Ginsburg and Amit, in 2008 conducted a case study with a preschool teacher that used mapping as her primary action for teaching math. The study was about her processes and actions but general observations and assumptions were made from that study. The preschool teacher planned experiences and created opportunities so that children had purposeful and spontaneous experiences especially if the experiences are meaningful to them. Teachers need to have knowledge of the subject matter and be able to make a connection to everyday experiences from abstract ideas regardless of the ages of children being taught (Ginsburg & Amit, 2008).

The researchers surmised that teachers need to have training both pre-service and in-service along with a more competent understanding of the key theories and practices for young children. Young children do not use the same skills on a concrete level—more spontaneously and sometimes joyfully with mathematical ideas (Ginsburg & Amit, 2008). An additional conclusion drawn from this case study was that teachers of young children must recognize and take into account difficult challenges.

Building Blocks is a National Science Foundation-funded project designed to enable all young children to build a solid foundation for mathematic (Sarama & Clements, 2004). This software designed program meets many of the criteria based on the same research as classroom interactions and was designed to be used within the curriculum. Instruction should start where children are to develop critical deeper learning, teaching is best in small groups. Technology can be significant if it is fully based on research and integrated into curriculum.

Children of 2020 (Sarama & Clements, 2010) describes the early years as critical years for learning math. Early literacy predicts the children's later achievement in reading but achievement in reading only. Children's early knowledge of math predicts not only later math achievement, but also later reading achievement. Math is about quantity, number, space and other related concepts, it is also a basic way to think (Sarama & Clements, 2010, p. 81).

A concern is that many programs only teach what children readily know, or give incorrect knowledge. It is important for creativity and mathematics capacities of young children to be built on. Learning trajectories: three parts; a mathematical goal, a

developmental path along which children develop to reach that goal, and a set of instructional activities, or tasks, linked to each of the levels of thinking in that path that help children develop higher levels of thinking (Sarama & Clements, 2010).

Summary

The review of literature provides an understanding about training in the early childhood field. Researchers examined how elementary teachers' math anxiety affected the level of math experiences offered to children in their classrooms but also transference of the anxiety to students. Much of the mathematical training has been limited to introduction and overview of concepts (Copley, 2010). Research is being conducted to support a deeper understanding and development of richer mathematical curriculum (Platas, 2008). Early childhood/elementary pre-service teachers may benefit from math courses that are taught in a more effective method for future students (Gresham, 2007).

Teachers have an impact on the students in their classrooms; improving teachers understanding of mathematic skills and methods of teaching will help reduce their anxiety levels (Vinson, 2001). Mathematical experiences that help develop early skills for young children in mathematical areas is very limited and this lack of early support leads to later issues when developing more complex math skills (Geary, 1994). Current research finds challenges facing the mathematical development in early childhood field (Copple & Bredekamp, 2009; Ginsburg & Golbeck, 2004; Sarama et al., 2004). There is very little to no support for caregivers, standards for early childhood mathematics has not been addressed until recently; (Copley, 2010; National Council for Teachers of Mathematics, 2002). Caregivers have limited knowledge of what is appropriate for

engaging young children in mathematical experiences (Platas, 2008). As communities of learning better understand the value of early childhood appropriate math experiences new opportunities will become available to the caregivers to increase their understanding of mathematics and how to provide rich opportunities for young children (NAEYC & NCTM, Early Childhood Mathematics: Promoting Good Beginnings, 2002)

CHAPTER III

METHODOLOGY

The study explored currently employed preschool caregivers' mathematical anxiety, their knowledge of children's mathematical development, and their beliefs about preschool mathematics curriculum. This chapter describes the research design, population and sample selection, protection of human participants, instrumentation, method of data collection, and plan for data analyses.

Research Design

The study utilized a descriptive, quantitative approach to identify dimensions of mathematical anxiety, as well as knowledge and beliefs related to children's mathematical development and curriculum in preschool classrooms. Mathematical anxiety scores were correlated with levels of knowledge and curriculum beliefs.

Setting

Bell and Coryell counties were located in Central Texas. Bell County had a total population of 285,787 with 50.5% being female and 10.3% children under the age of five. Coryell County had a total population of 72,529 with 49.5% female and 6.2% under the age of five (State & county quick facts, 2010). Fort Hood Military Base was located in both counties and the residents were included in the population of the counties (Census Designated Place, 2005).

The two community colleges offered degrees and certificates in Child Development. Central Texas College enrolled approximately 400 Child Development

students and operated a laboratory school serving preschool children in the fall of 2010. Temple College enrolled approximately 120 child development students in the fall of 2010 semester. There were four accredited child care centers located at Fort Hood Military Base, Texas. Military child care centers were not governed by state licensing regulations but were regulated by AR 608-10 of Army Regulations. Bell County had 157 fully licensed child care programs serving preschool children. Coryell County had 26 fully licensed child care programs serving preschool children (Texas child care licensing, n.d.).

Population and Sample

The population consisted of approximately 500 caregivers of preschool children who were employed 15 or more hours per week in Bell or Coryell counties. The population included students who were enrolled in Child Development courses at Central Texas College and Temple College during the fall semester of 2010. In addition, employees at the Fort Hood Military Base military child care centers and employees of fully licensed child care centers in Bell and Coryell counties comprised the target population. The sample was comprised of volunteers who meet the eligibility requirements and completed the surveys.

Instruments

The study utilized four measurements: a demographics questionnaire, the Mathematics Anxiety Scale—Revised (Bai, 2010), the Knowledge of Mathematical Development Survey (Platas, 2008), and the Beliefs Survey (Platas, 2008). Permission

from Bai and Platas was obtained to use their tools (see Appendix A). The tools are included in this study (see Appendix B).

The Demographics Questionnaire included 15 items that addressed employment status, gender, age, ethnicity, student status, education levels, college math courses, professional development, years working with children, job title, program types and sizes, funding sources, and accreditation.

The Mathematics Anxiety Scale—Revised (MAS-R) created by Bai (2010) was a revised version of an earlier instrument designed by a team led by Bai at the University of Central Florida. This newer version included positive and negative affect as two dimensions of math anxiety. The instrument was validated with an ethnically diverse sample of secondary students. Validity was established based on literature reviews and the judgments of experts. Predictive validity was tested by correlating math anxiety scores with students' performance on mathematics benchmark tests. Higher anxiety scores were negatively and significantly correlated with lower performance scores in a sample of 647 participants.

Reliability of the instrument was assessed by calculating internal consistency. The author reported Cronbach's alpha values of 0.81 for the total scale, 0.78 for the positive subscale and 0.86 for the negative subscale.

The MAS-R consisted of 14 items that were rated on a Likert scale from "not true" (1) to "very true" (5). The positive and negative dimensions were identified through factor analysis. The Positive Affect subscale consisted of six items. Examples included the following.

"Item 1: I find math interesting."

"Item 13: I enjoy learning with mathematics." (Bai, 2010, p. 5)

The Negative Affect subscale consisted of eight items. The following are examples.

"Item 9: Mathematics makes me feel nervous."

"Item 14: Mathematics makes me feel confused." (Bai, 2010, p. 5).

The subscale scores were calculated by adding the item ratings and dividing by the number of items, thus providing mean scores based on a one to five scale. A higher score indicates a more positive or more negative affect regarding mathematics.

The Knowledge of Mathematical Development Survey (KMD) and the Beliefs about Mathematics Teaching and Learning in the Preschool Classroom Survey were developed as a two-survey instrument set by Platas (2008) as her dissertation study. The KMD was designed to measure the sequence in which young children develop concepts of mathematics. The Beliefs about Mathematics Teaching and Learning in the Preschool Classroom Survey measured beliefs concerning

(a) age-appropriateness of mathematical instruction in the early childhood classroom;

(b) locus of generation of mathematical knowledge;

(c) social and emotional versus mathematical development as primary goals of preschool; and

(d) teachers comfort level in mathematics instruction" (Platas, 2008, p. 6).

Validity of KMD and Beliefs was established through the use of cognitive interviews with college students, literature reviews, a pilot study involving three groups and interviews with experts in the field. The first group included students just beginning careers in the Early Childhood Education field with no related work experience, no Early Childhood Education (ECE), and no mathematical development course exposure. The second group was indicative of many of the teachers currently in the field. This group was composed of third and fourth year university students with two or more years of in-service experience and 12 or more units of ECE education. The third group included teachers in a master's program with two or more years of in-service experience, and enrollment in a degree-required mathematical development course. The mean scores of the three groups differed significantly, indicating that the instruments discriminated between groups based on education and in-service experiences. This provided further evidence of instrument validity.

The KMD was a 20 question multiple choice survey. A series of statements compared the order in which children's math skills are developed. Many of the statements included a pictorial description. For each item, respondents selected the skill which a child was likely to learn first. All items include the options to select "Same" or "Do not know."

Examples taken from the KMD include items 18 and 19 (Platas, 2008, p. 150).

18.

In a line of five toy sheep facing the same direction, Indigo answers the question, "Point to the second sheep in the line." 

In a line of five toy sheep facing the same direction, Indigo answers the question, "Point to the first sheep in the line."

Same

Do not know

19.

Payton counts a group of 8 buttons (not in a row).

Peyton counts a row of 8 buttons.

Same

Do not know

Scoring was based on the number of correctly identified sequences. The total score was represented as the percentage of correct items.

Reliability for the KMD was based on a sample of 144 students. A Cronbach's alpha value of 0.81 was reported by the author (Platas, 2008, p. 89).

The Beliefs Survey (Platas, 2008) consisted of 40 items that were rated on a Likert Scale from "Strongly Agree" (1) to "Strongly Disagree" (6). Items were grouped into four domains.

Age-appropriateness of Mathematical Instruction in the Early Childhood Classroom included the following 10 items, numbered 2, 3, 4, 15, 22, 29, 31, 35, 37, 39. The ratings were reversed for items 4, 15, 22, 35, 39. The following was a sample item.

"Most preschoolers are ready for participation in math activities" (Platas, 2008, p. 190).

Locus of Generation of Mathematical Knowledge included the following 12 items: 6, 8, 10, 13, 18, 19, 23, 25, 32, 33, 36, 38. The ratings were reversed for items 6, 10, 13, 18, 19, 25, 32, 33, 36, 38. The item below is an example of this item.

> "Preschoolers should learn *specific* procedures for solving math problems (i.e., 2+4)" (Platas, 2008, p. 191).

Social and Emotional versus Mathematical Development as Primary Goals of Preschool Education included the following 8 items: 1, 7, 9, 12, 16, 20, 26, 28. The ratings were reversed for items 1, 7, 9, 12. The following was an example of the items in this area.

> "Preschool children are *not* socially or emotionally ready for math activities" (Platas, 2008, p. 192).

Teacher Comfort in Mathematical Instruction included the following 10 items: 5, 11, 14, 17, 21, 24, 27, 30, 34, 40. The ratings were reversed for items 5, 21, 27, 30, 40. The following was an example of this item.

> "Math is/would be a difficult subject for me to teach in preschool" (Platas, 2008, p. 193).

Scoring for each of the domains was calculated by adding the ratings and dividing by the number of items. Domain scores were then based on the 1 to 6 scale. The higher scores on the Age-appropriateness of Mathematical Instruction in the Early Childhood Classroom domain indicated a higher level of understanding that math is age appropriate for preschool children. The higher score on the Locus of Generation of Mathematical Knowledge domain indicated a belief that it is both teachers and children's responsibility

for generating mathematical learning. The higher score in the domain of Social and Emotional versus Mathematical Development as Primary Goals of Preschool Education revealed that caregivers have a high understanding that mathematical development is important. The higher score of Teacher Comfort in Mathematical Instruction domain pointed to the caregiver as very comfortable with classroom support of mathematical development.

Reliability for the domains of the Beliefs Survey was determined using Cronbach's alpha. Values reported by the author ranged from 0.83 to 0.93 (Platas, 2008, p. 101). The author's Chonbach's alpha of the four subscale were "Locus of Generation of Mathematical Knowledge" domain, alpha =0.829 ; "Age-Appropriateness of Mathematical Instruction in the early childhood classroom" domain , alpha = 0.926; "Social and Emotional versus Mathematical development as Primary Goals of Preschool" domain, alpha = 0.858; "Teacher Comfort in Mathematical Instruction" domain , alpha =0.895. (Platas, 2008, p. 100).

Procedures

Protection of Human Participants

The research study was conducted in accordance with the requirements of the Texas Woman's University Institutional Review Board. Informed consent was part of the survey packet (see Appendix C).

Confidentiality was ensured throughout the study by not connecting the consent form with the actual survey. Confidentiality was protected by having each participant sign the consent form before participating in the surveys. The consent form was returned

in a separate white 4 1/8 x 9 ½ envelope. The participant sealed the consent form in the envelope before returning it and the survey to the collection site for the researcher.

The participants were reminded in the survey instructions that they had the right to withdraw from the research at any time without penalty. The participants were informed by the survey instructions that they could stop the survey or take a break at any time (see Appendix D).

Site Agreements to Collect Data

Letters of agreement were obtained from each child care program that agreed to participate in the study. The researcher made available a copy of a sample letter of agreement for programs (see Appendix E).

Community colleges. The researcher was the Child Development Department Chair at Temple College therefore the letter of agreement was approved by the Vice President of Educational Services. The Child Development Department Chair of Central Texas College was approached to get their permission to conduct the dissertation study with child development students that met the criteria of the study and the preschool caregivers from the laboratory school.

Fort Hood Military Base. Fort Hood Military Base child development administrator was approached to allow the military centers to participate in the study. The military system distributed the information through their distribution system after administrative approval was obtained. The letter of agreement was obtained from the administration and then each center was approached to voluntarily participate.

Local child care programs. Local child care programs identified by the Texas Child Care Licensing web site as fully licensed child care programs in Bell and Coryell counties were contacted to participate in the study. The researcher sent a copy of the request to participate and a sample letter of agreement electronically, by mail, or contacted the centers by phone call and delivered the sample letters by hand to the centers.

Introduction of the research project was done at quarterly Texas Workforce Solutions meetings, local director meetings and trainings. Included in the attendance were representatives from Community Colleges, Fort Hood Military Base centers along with local center directors. All fully licensed or military centers were contacted by electronic mail or phone contact to ask the directors to complete the agreement letter on company letterhead and indicate how many currently employed preschool caregivers were at their site.

Second contacts. Follow-up phone contacts were made to non-responsive directors to ensure a good sampling of child care programs in both counties were represented. Centers that did not responded to the initial request to participate were contacted with personal calls from the researcher. Center visits with the director to explain the study and procedures to participate were made if a program was interested in participating. Programs that wanted to participate completed a letter of agreement before any packets were provided. Programs were reminded that individual participation must be voluntarily.

Data Collection

The researcher and assistant created packets of the four questionnaires: Demographics Questionnaire, Math Anxiety Scale-Revised, Knowledge of Mathematical Development Survey, and Beliefs about Mathematics Teaching and Learning in the Preschool Classroom Survey. The survey packet was placed inside a 9 x 12 clasp envelope with consent forms and white 4 1/8 x 9 ½ consent form envelopes. The consent forms were turned in to the center director separately from the survey envelopes. The instructions were stapled to the front of the clasp envelopes.

The instructions directed participants to complete the consent form and place it in the small white envelope. The instructions asked the participants to complete the four part survey. The surveys took approximately 20 minutes to complete. The surveys were put back into the 9 x12 clasp envelope, and then both the survey envelope and separate consent form envelope were returned to the director or instructor. The director or instructor placed all white consent form envelopes in a larger envelope labeled consent forms. Participants were made aware of the fact that participation is voluntary and they could stop and return the survey packet at any time. Instructions for the community colleges substituted the instructor for the director to turn in packets to.

Temple College. Temple College was the work site of the researcher. The department chair, the researcher, provided surveys to instructors who agreed to make the surveys available to eligible child development students in their classes. Surveys were also provided to researcher's child development students by announcing the survey and that survey packets were available for pickup near the exit of the classroom. All eligible

students were offered an opportunity to complete the survey packets to include consent form and return to the Technology Division secretary's office. The researcher collected the survey packets from the division secretary. All research consent forms for the study were maintained by Temple College Technology Division secretary in a locked cabinet for the duration of the project.

Central Texas College. The Central Texas College department chair offered the survey packets to all instructors interested in allowing students to participate. The department chair distributed the survey packets to instructors to offer to eligible students to voluntarily complete. Surveys were turned in with the consent forms in the separate consent form envelope to the instructor or the Laboratory School Director's office. Laboratory preschool caregivers were also given the opportunity to participate in the survey and return the survey packet and consent form to the Laboratory School Director's office. The researcher or assistant picked up the survey packets and separate consent form envelopes.

Fort Hood Military Base. The Fort Hood Military Base centers had survey packets with consent forms delivered. Center Directors distributed survey packets to all eligible preschool caregivers that expressed an interest in completing the survey. The researcher came by on a weekly basis to collect all completed survey packets and consent forms that were maintained in a separate envelope labeled for that purpose.

Local centers. Local center's survey packets were personally delivered to each center that agreed to participate. Survey packets were picked up by researcher or assistant weekly or when center called for pickup. Consent forms were collected and placed in a

separate 9 x 12 envelope. The completed consent forms were collected with the survey packets in a separate envelope and kept in the Temple College Business and Technical division secretary's locked cabinet. Survey packets were collected and kept by researcher for data entry.

Incentives. A Math Activity Booklet of six to eight preschool math activities and a resource list of activity books and websites were provided to each preschool caregiver. Child development programs that participated in the study were given a Math Activity Booklet for each of their preschool caregivers, regardless of the individual participation in the research. The researcher and assistant delivered the booklets to the program directors in June, 2011. All Temple College and Central Texas College students enrolled in child development classes were offered the Math Activities Booklet through class instructors.

The researcher conducted child development professional development in the community in 2011. The professional development summarized the findings of the study and answered questions from the audience. Math beliefs and curriculum was the focus of the professional development with activities and how to make them meaningful to the children incorporated. The researcher submitted a proposal to provide professional development at the state conference in 2011.

Reminder. Packets were scheduled for pick up within a week of delivery to child care centers. Centers could call if they wanted materials picked up earlier or later. Centers that did not have packets ready for pick-up were called to determine when an appropriate pick-up time could be scheduled.

Plan for Analyses

Raw data was entered by researcher into the Statistical Package for the Social Sciences version 18 (SPSS 18). The responses to the Demographic Questions were reported as frequencies and percentages. The data was displayed in tables and pie charts.

The Mathematics Anxiety Scale—Revised (MAS-R) was analyzed by reporting frequencies and percentages for each of the 14 items. A total mean score was calculated for the dimension of Positive Affect and Negative Affect by adding the items and dividing by the number of items in each dimension. Means and standard deviations were reported for the dimensions mean totals. A bar chart displayed the means. The items within each subscale were ranked by the means and standard deviations and then reported in tables.

The 20 items in the Knowledge of Mathematical Development Survey (KMD) were reported in frequencies and percentages for items. A total score was based on the number of correct items, reported as a mean and standard deviation. Tables were used to report the results.

The Beliefs about Mathematics Teaching and Learning in the Preschool Classroom Survey about math for young children was analyzed by calculating frequencies and percentages for the 40 items. The domain totals mean scores were calculated by adding the items and dividing by the number of items in the domain. Scores of the four domains were reported as means and standard deviations: Age appropriateness of mathematics instruction in the early childhood classroom, Locus of Generation of Mathematical Knowledge, Social and Emotional versus Mathematics Development as

Primary Goals of Preschool, and Teacher Comfort in Mathematics Instruction. The results were reported in tables with the items listed from the highest to the lowest ratings of agreement.

Pearson Product-moment correlation coefficients were calculated to determine relationships among the variables measuring mathematics anxiety, knowledge about math development, and Beliefs about Mathematics Teaching and Learning in the Preschool Classroom.

1. Total scores for the Knowledge of Mathematical Development were correlated with the four domains of the Beliefs about Mathematical Teaching and Learning in the Preschool Classroom Survey.
2. Total Knowledge of Mathematical Development (KMD) scores were correlated with MAS-R Positive Affect and Negative Affect total mean scores.
3. Total mean scores of the four domains of the Beliefs about Mathematical Teaching and Learning in the Preschool Classroom Survey were correlated with MAS-R Positive Affect and Negative Affect total mean scores.

A summary table displaying the research questions, the variables of concern, and the resulting statistics is presented in the following table.

Table 1

Research Questions Data Analyses

Research Question	**Variables**	**Statistics**
1. What are the dimensions of mathematical anxiety expressed by preschool caregivers?	Mathematics Anxiety Scale –Revised (MAR-S) Positive Affect Negative Affect	Means and Standard deviations of positive affect and negative affect
2. What do preschool caregivers know about mathematical development?	Knowledge of Mathematical Development Survey (KDM)	Total score (higher score = higher knowledge) Means and Standard Deviations
3. What are preschool caregivers' Beliefs about Mathematics Teaching and Learning in the Preschool Classroom?	Beliefs Survey Four Domains: -Age-appropriate -Locus of Generation of Knowledge -Socio-Emotional vs. Mathematical Development -Comfort of Instruction	Means and Standard Deviations for the four domains
4. Are there correlations between Knowledge of Mathematical Development (KMD) and Beliefs about Mathematics Teaching and Learning in the Preschool Classroom?	KMD total mean scores and Beliefs Subscale mean Scores	Pearson Product-moment correlation coefficients
5. Are there differences in mean Knowledge of Mathematical Development (KMD) scores when caregivers are grouped by Math Anxiety Scale-Revised (MAS-R) scores?	KDM total by MAS-R High Positive Affect, High Negative Affect and Mixed Affect groups correlated with KMD total mean scores.	ANOVA.
6. Are there any differences in the four Beliefs about Mathematics Teaching and Learning in the Preschool Classroom subscales scores when caregivers are grouped by Math Anxiety Scale-Revised (MAS-R) scores?	Beliefs Survey four subscale mean scores MAS-R High Positive Affect, High Negative Affect and Mixed Affect groups	MANOVA

Summary

This chapter describes the population sample, research design, procedures and analyses of this descriptive study. The selection of individuals from community college programs and Fort Hood Military Base centers and local centers are described. Eligibility for participation is explained. The procedure of instrument implementation is described. Protection of human participants is addressed in this chapter.

CHAPTER IV

RESULTS

The purpose of this research was to identify preschool caregivers' math anxiety and how it is related to their knowledge and beliefs about math for preschool children. Preschool caregivers were asked to report on demographics, math anxiety levels, knowledge of preschool children's math development and beliefs about math curriculum for young children.

Setting of Study

Data was collected from preschool caregivers in fully licensed child care centers and the military child care centers in Bell and Coryell Counties in Central Texas. The list of fully licensed child care centers in Bell and Coryell Counties was used to identify centers that enrolled preschool children. In Bell County there were 122 centers; in Coryell County there were 20 centers. All YMCA centers were eliminated from the total number because the programs only offered afterschool childcare during the school year. Administrators of centers declined to participate in the study either through email, telephone conversations or at the time survey packets were retrieved. Therefore there were a total of 142 centers eligible to participate in the study. A total of 59 centers were contacted which represented 42% of the centers in the two counties. A total of 51 centers which represented 36%, agreed to allow the survey to be offered to their preschool caregivers.

Fully licensed child care programs in Bell and Coryell counties were contacted by email. Few centers responded to the initial email request to allow preschool teachers to participate in the survey. Follow-up phone calls were made to centers using the September 2010 licensing list of programs. Individual administrators were called of centers according to location, program size and structure. Centers that had child development students and former students were contacted. Administrators of seven centers declined to participate. The last week of the study the researcher made an effort to balance the total number of centers between private and church affiliated centers. A total of 39 programs in Bell County and 12 in Coryell County participated in the study. The following table describes the participating programs and numbers of responding caregivers.

Table 2

Participating Child Care Programs in Bell and Coryell Counties in Texas

Name of Center	County	Employed	Respondents
Alpha Time Two	Coryell County	2	2
Bear Hugs Learning Center	Bell County	3	3
Belton Education Station	Bell County	6	5
Busy Bee	Bell County	2	2
Belle Oaks Head Start	Bell County	2	2
Belton Southwest Head Start	Bell County	3	3
Bethune Head Start	Bell County	4	4
Central Texas Children's Center	Bell County	2	2
Crenshaw-Harris	Bell County	1	1
Christ Church School	Coryell County	6	4
Copperas Cove Head Start	Coryell County	12	12
Creative Child Learning Arts	Bell County	5	5

(continue)

Table 2 continued

Name of Center	County	Employed	Respondents
Central Texas College Lab School	Bell County	6	6
Dickson Head Start	Bell County	4	4
First United Methodist Church	Bell County	2	2
Fort Hood, Chaffee Village	Bell County	3	2
Fort Hood, Clear Creek	Bell County	13	4
Fort Hood, Comanche	Coryell County	14	5
Fort Hood, Head Start	Bell County	5	2
Fort Hood, Main Center	Bell County	12	11
Heaven's Little Miracles	Coryell County	1	1
Hal Rose Head Start	Bell County	4	3
Harker Heights Head Start	Bell County	5	3
Kaleidoscope	Bell County	6	6
Killeen Head Start South West	Bell County	4	4
Kid Grace	Bell County	4	3
Kid's World CDC	Bell County	1	1
Learning Zone, Harker Heights	Bell County	4	3
Learning Zone, Killeen	Bell County	2	2
Log Cabin	Bell County	4	1
Marlboro Heights Head Start	Bell County	3	3
Milestones	Bell County	20	11
Moss Rose Head Start	Bell County	3	2
Peanut Gallery	Bell County	32	20
Park Head Start	Coryell County	5	4
Perfect Praise Day Care	Coryell County	13	10
Quality Time Day Care	Bell County	1	1
Saulsbury Jean Wilson Center	Bell County	1	1
Sinai Christian CDC	Coryell County	4	3
St. Christopher's Preschool	Bell County	4	4
Sunset Head Start	Bell County	2	2
Sunshine Head Start	CoryellCounty	5	5
Sweet Steps Child Care	Bell County	1	1
Trinity Chapel	Coryell County	2	2
Turkey Creek Junior Academy	Coryell County	2	2
Tweety Day Care	Bell County	1	1
Young World	Bell County	2	2

A total of 51 child care centers participated in the study. Thirty-nine of the child care programs were located in Bell County and twelve were in located in Coryell County.

Description of Sample

The participating centers employed 273 preschool caregivers, of those 207 completed the survey packets, producing a 76% return rate on the surveys. Eligibility was limited to preschool caregivers who work in 15 or more hours. The demographic questionnaire elicited information about the gender of the respondents. The sample was comprised of 205 females and two males. The ages of caregivers ranged from 18 to more than 60 years. Caregivers between the ages of 40 and 49 were the largest age group of caregivers (28.3%). The age groups are displayed in the following table and figure.

Table 3

Frequencies and Percentages of Age Groups

Age Groups	*f*	%
18-24 years	24	11.7
25-29 years	33	16.1
30-35 years	39	19.0
36-39 years	18	8.8
40-49 years	58	28.3
50-59 years	29	14.1
60 + years	4	2.0

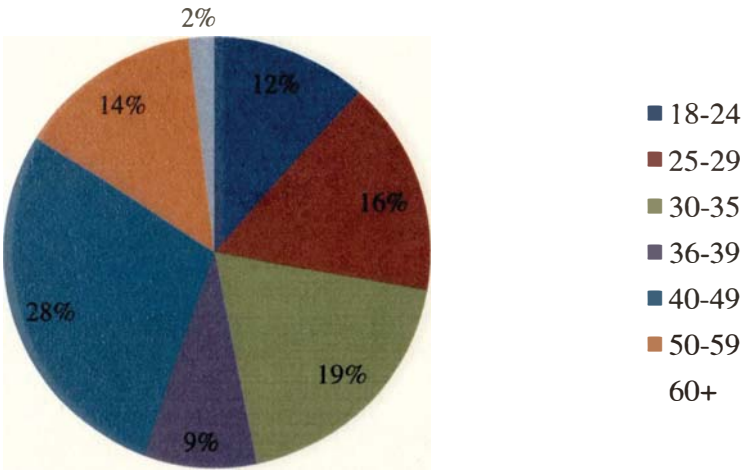

Figure 1. Percentages of age groups.

The ethnicities of the caregivers included 68 African-American; 3 Asian/Asian-American/Pacific Islander; 85 Caucasian; 42 Hispanic, and 3 Native-American/American Indian/Alaskan Native. Five caregivers said they were "Others." These identified themselves as Italian-African-Jamaican; Mexican; Russian; White-Hispanic and one unspecified.

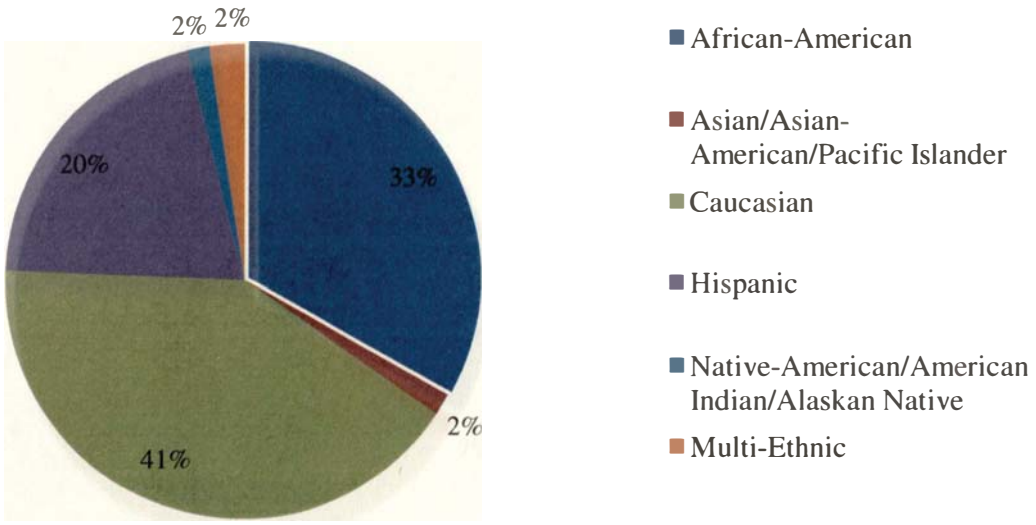

Figure 2. Ethnicity of caregivers.

Caregivers were asked to identify the highest level of education completed. Demographics question gathered information about the highest level of education preschool caregivers had. Education levels ranged from General Educational Development Certificate (GED) to Master's Degree. The largest category reported "some college" (32.9%). Fifty-eight caregiver currently enrolled in college courses represented 28% of the total sample.

The table below describes the levels of education caregivers' education.

Table 4

Frequencies and Percentages of Caregivers' Highest Level of Education

Levels of Education	*f*	%
GED	4	1.9
High School	45	21.7
Some College	68	32.9
Child Development Certificate	22	10.6
Associate's Degree	30	14.5
Bachelor's Degree	31	15.0
Master's Degree	4	1.9
Other	3	1.4

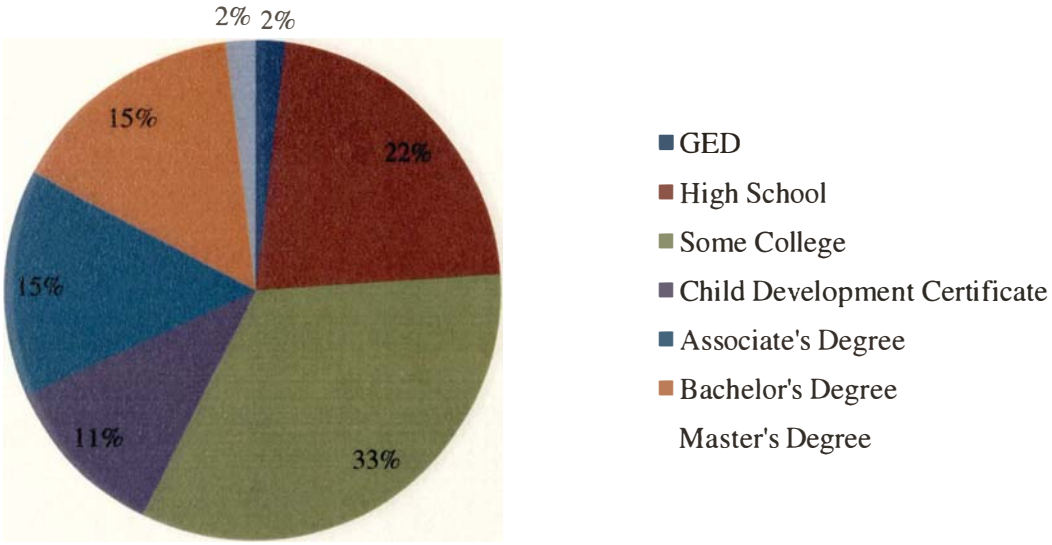

Figure 3. Caregivers' levels of education.

Caregivers were asked to identify more specifically their educational backgrounds in Child Development or Teacher Preparation. Respondents selected all categories that applied. The frequencies in Table 5 represent the numbers of caregivers who replied in each category. The CDA was the most frequently selected level.

Table 5

Frequencies and Percentages of Education Levels in Child Development or Teacher Preparation.

Levels of Education	*f*	%
Early Childhood Certificate (one year)	41	19.8
Child Development Associate (CDA)	64	30.9
Associate's Degree (two years)	26	12.6
Bachelor's Degree	24	11.6
Teacher Certification	22	10.5
Master's Degree	4	1.9

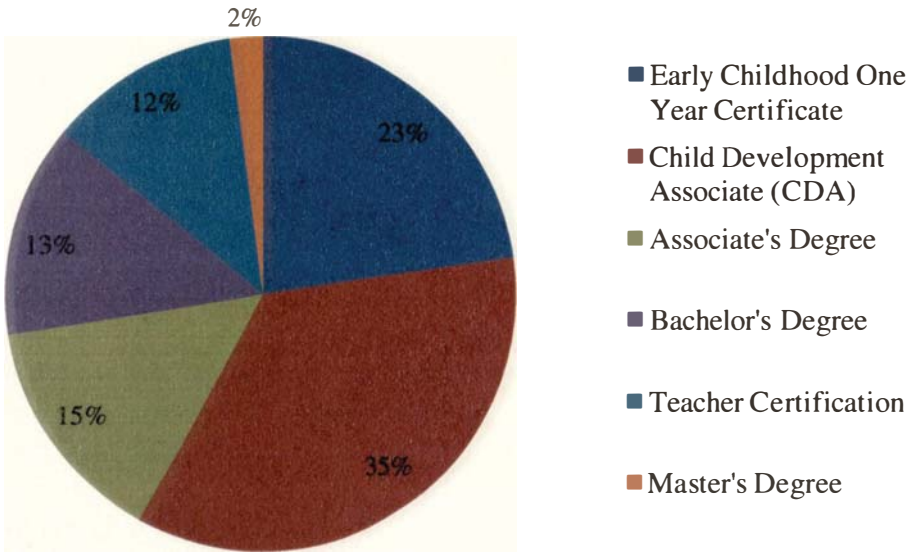

Figure 4. Education levels in child development or teacher preparation.

Caregivers self-reported the year of high school completion. The years were grouped in five-year increments that ranged from 1960 to 2010. This information is reported in the following table and figure.

Table 6

Frequencies and Percentages of Caregivers' Years of High School Completion

Year of High School Graduation	*f*	%
1960-1969	6	3.4
1970-1974	10	4.8
1975-1979	12	5.8
1980-1984	24	11.7
1985-1989	26	12.5

(Continue)

Table 6 continued

Year of High School Graduation	*f*	%
1990-1994	23	11.1
1995-1999	36	17.3
2000-2004	27	13.0
2005-2010	25	12.0
Not Reported	17	8.2

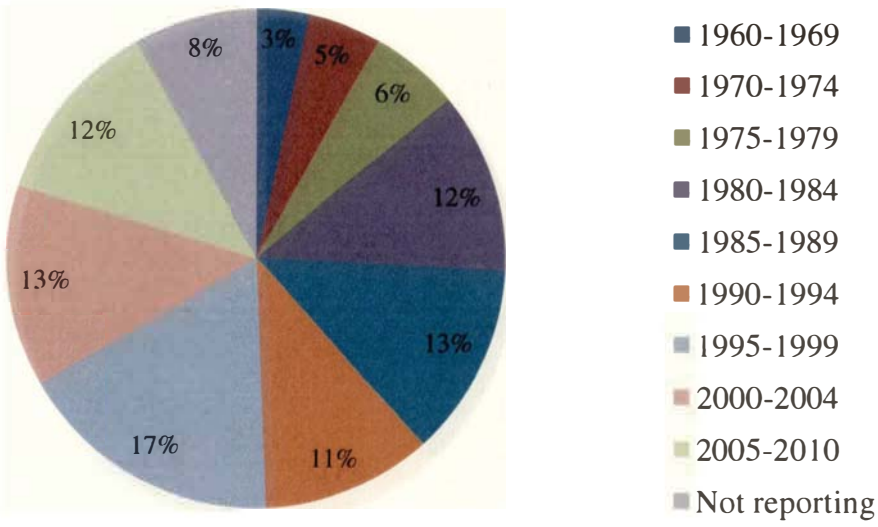

Figure 5. Years participating caregivers completed high school.

The highest level of high school math was self-reported. Some caregivers identified the grade level, while others reported the content of the math course. The results are displayed in the following table and graph.

Table 7

Frequencies and Percentages of Highest Levels of High School Math Courses

High School Math	*f*	%
Not Reported	27	13.0
9th grade math	1	0.5
11th grade math	4	1.9
12th grade math	23	11.1
Pre-algebra	3	1.4
Algebra	43	20.8
Geometry	19	9.2
Algebra II	40	19.4
Algebra III	1	0.5
Business Math	4	2.0
Pre-calculus	12	5.8
Calculus	10	4.9
Trigonometry	7	3.4

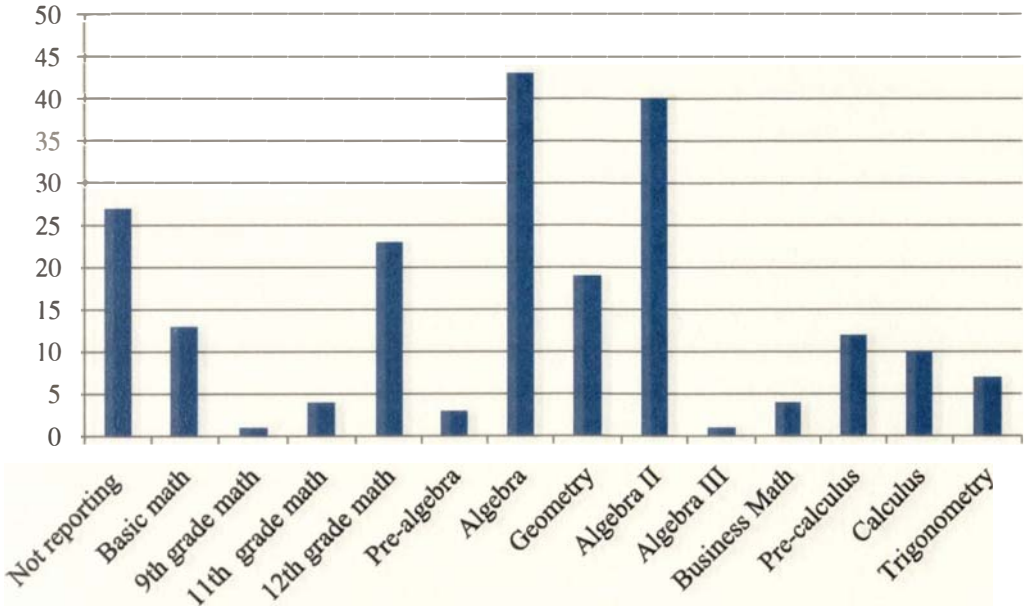

Figure 6. Frequencies of highest level of high school math courses.

The level of college mathematics completed was identified by asking caregivers' to respondent to the question with either "No" or the level of college math they had completed. The respondents that said they had completed college math 12.6%; respond with completion of developmental math; 34.3% had completed college math and 6.8% indicated completion of math for young children. Participants with no college math were 46.4% of the responses.

Professional development participation in the area of math for young children over the last 3 years resulted in 51.7% indicated including math for young children in their professional development with 37.2% not having included math for young children in their professional development over the last 3 years. Participants indicate in 11.1% of the responses that they were uncertain if they had involved in math for young children.

Information about the number of years a caregiver has been working in the field of child development was asked. The largest percent of caregivers reported that they had been in the profession for five to ten 10 years. The results are displayed in the table and figures that follow.

Table 8

Number of Years as Caregiver

Number of years as caregiver	*f*	%
1 year	23	11.1
2 years	18	8.7
3-4 years	23	11.1
5-10 years	77	37.2
11-15 years	32	15.5
16-20 years	15	7.2
21-29 years	15	5.8
30+ years	7	3.4

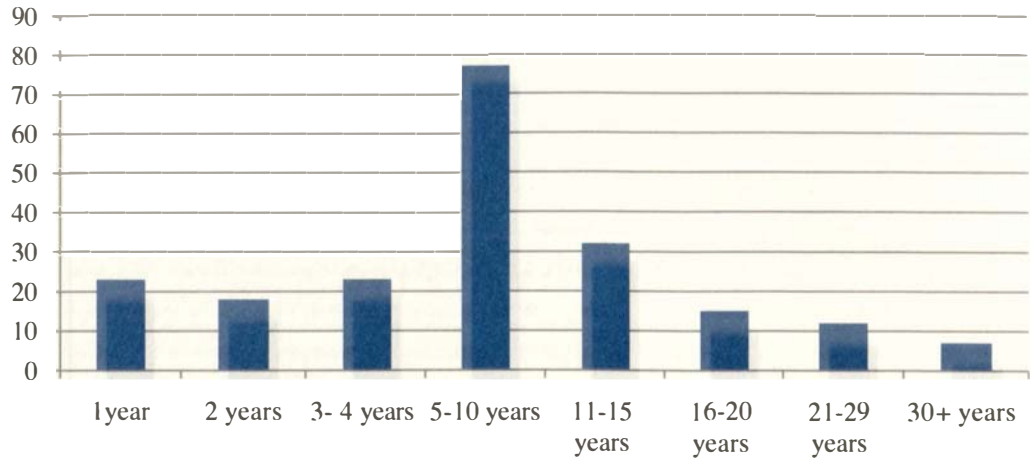

Figure 7. Number of years as caregiver.

Caregivers selected from the available choices for job titles. The highest response that matched caregivers' description of their position was "Lead Teacher" at 50.2%. Participants self-reported specific job title as: curriculum coordinator, 1=0.5%; family advocate 1=0.5%; Program asst 3=1.5%; Teach manager 1=0.5%; Results are reported in the following table and figure.

Table 9

Frequencies and Percentages of Job Titles

Job Titles	*f*	%
Lead Teacher	103	50.2
Assistant	59	28.8
Substitute	6	2.9
Teacher/Director	29	14.1
Other	8	3.9
Not reporting	2	1.0

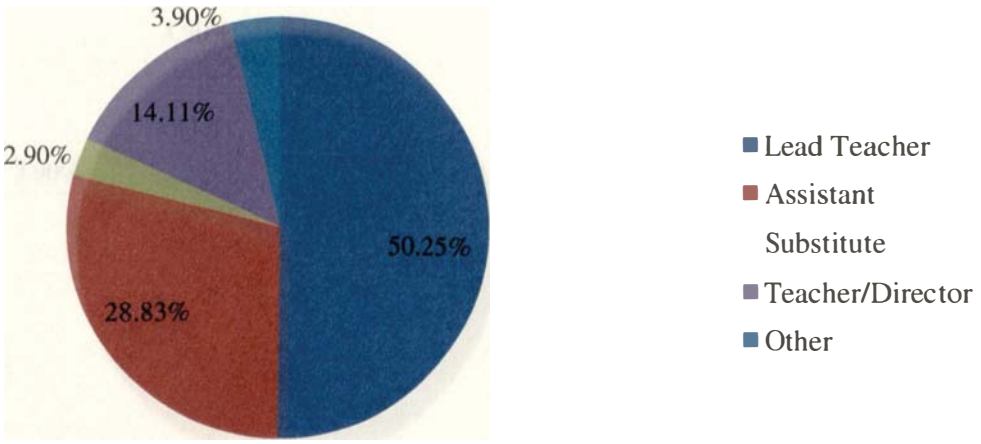

Figure 8. Percentage of job titles.

Caregivers indicated the combined age group of 3 and 4 year olds was the most reported classroom age. The age groups that the respondents indicated that they worked with in indicated in the tables and figures below.

Table 10

Frequencies and Percentages of Preschool Age Groups Taught

Clas room age group	*f*	%
Four year olds	18	8.7
Five year olds	3	1.4
Combined 3 &4 year olds	54	26.1
Combined 4 & 5 year olds	40	19.3
Combined 3 & 4 & 5 year olds	53	25.6

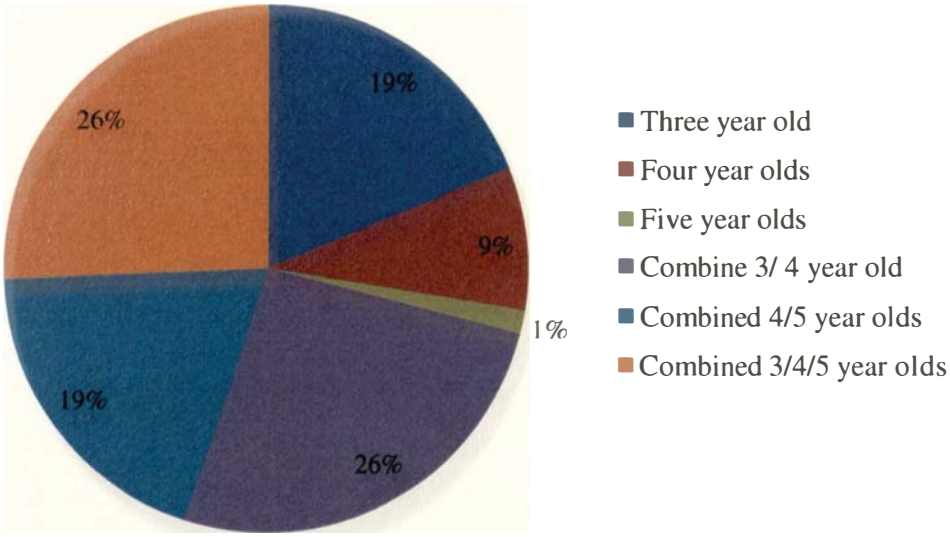

Figure 9. Percentages of age groups taught.

Caregivers were employed in programs with a rage of licensed capacity. The table reflects the caregivers' reports of the maximum numbers of children the program served.

Table 11

Frequencies and Percentages of Program Enrollment

Enrollment capacities	*f*	%
Less than 20	28	14.3
76 to 100	23	11.7
100 to 150	24	12.2
200 +	29	14.8

Caregivers selected the organizational type of the child care programs where they were employed. The results are displayed in the following table and figure.

Table 12

Frequencies and Percentages of Organizational Types of Child Care Programs

Type of Program	*f*	%
Head Start	67	32.4
Church affiliated	58	28.2
Privately owned	52	25.1
Military	22	10.7
Corporate/Franchise Municipal programs	7	3.4

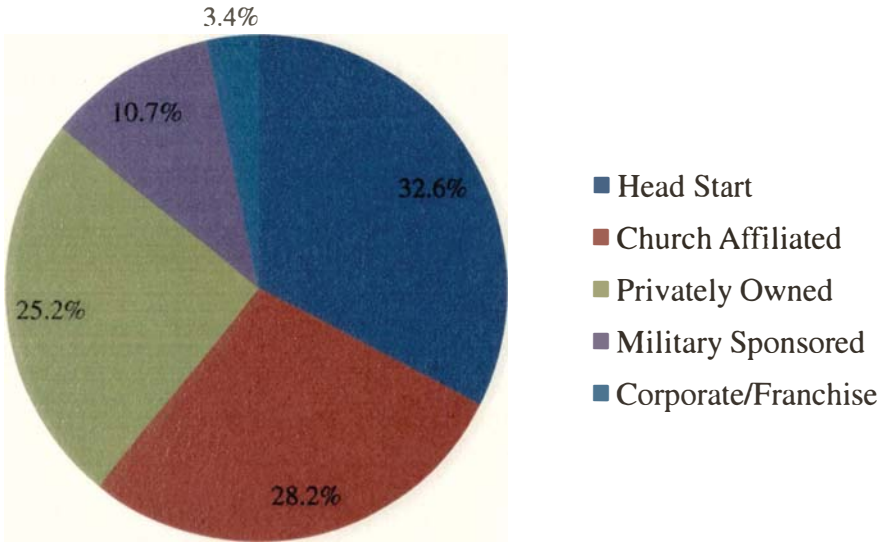

Figure 10. Types of centers caregivers reported working in.

National Association for the Education of Young Children (NAEYC) Accreditation is a national, voluntary program that has set professional standards for early childhood education programs, and helped families identify high-quality programs for their young children (NAEYC Accredition, 2010). One church center indicated accreditation by National Private School Association (NPSA) an educational association of private Christian schools serving educators and students nationwide. Schools are independent and governed by a self- perpetuating board of directors (NPSA, 2010). A third program identified accreditation by NACCRRA, the National Association of Child Care Resource & Referral Agencies, is a non-profit organization dedicated to providing child care information to parents and communities through their assurance program (NACCRRA, 2010).

In Bell and Coryell counties there were eight accredited centers. The military sponsored five of the accredited centers with a Head Start collaboration and there was one Municipal center supported by the city housing authority. Forty seven caregivers responded that they worked in NAEYC accredited centers; one responded that they worked in a NPSA accredited center and three indicated they worked in a NACCRRA program. This was 48 of the total respondents indicating that they work in accredited centers and 159 that did not work in accredited centers.

Mathematical Anxiety

Caregivers' anxiety about mathematics was measured using the Math Anxiety Scale—Revised (MAS-R) (Bai, 2010) there were 14 items list the possible answers --- not true, slightly true, moderately true, mostly true, very true (Bai, 2010). The author identified two domains positive consisting of 6 items and negative consisting of 8 items.

Reliability was calculated using inter-item correlation. The Cronbach's alpha value calculated for the Positive Affect domain was 0.83. This compared favorably with the reliability reported by the author of the instrument. The Negative Affect domain produced a Cronbach's alpha value of 0.94. This was higher than the 0.84 alpha reported by Bai (2010).

The current study looked at how the respondents answered the questions self-describing their level of mathematical anxiety. Preschool caregivers' responses were coded into High Positive Affect or High Negative Affect of anxiety. Upon analysis of the means it was identified that a large percent of the caregivers did not fall into these two

categories, a third category was created, the mixed affect. The results of the current study were reflected in the data and analysis of the items and further analysis was conducted.

Research Question One: What Are the Dimensions of Mathematical Anxiety Expressed by Preschool Caregivers?

The sample of 207 caregivers responded to the 14 items by selecting the ratings that best matched their feelings about mathematics. The items are arranged in order of very true-mostly true, moderately true, slightly true- not true within each domain. The following table and figure displays the results for the Positive Affect domain.

Table 13

Frequencies and Percentages of the Positive Affect Domain

			Very true to Mostly true		Moderately true		Slightly true to Not true	
#	Items	*n*	*f*	%	*f*	%	*f*	%
3	I think that I will use math in the future.	206	150	72.8	41	19.9	15	7.2
5	Math relates to my life.	206	115	55.8	55	26.7	36	17.5
1	I find math interesting.	207	92	44.4	66	31.9	49	23.6
10	I would like to take more math classes.	207	70	33.8	43	20.8	94	45.4
13	I enjoy learning with mathematics.	207	59	28.5	62	30	86	41.6
12	Math is one of my favorite subjects.	207	55	21.7	29	14	133	64.3

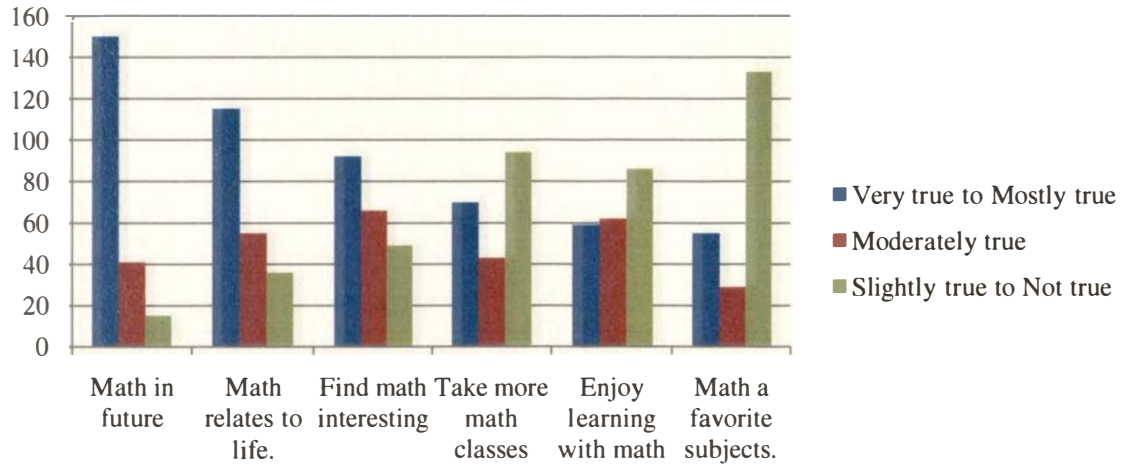

Figure 11. Frequencies of responses to the positive affect items.

The responses the author identified as negative items are reflected in the table. They are arranged in the order of very true-mostly true, moderately true, slightly true -not true within each domain. The table shows the frequencies and percentages of each item.

Table 14

Frequencies and Percentages of Negative Affect Domain

			Very true to Mostly true		Moderately true		Slightly true to Not true	
#	Items	*n*	*f*	%	*f*	%	*f*	%
8	I find math challenging.	207	99	47.8	56	27.1	52	25.1
2	I get uptight during math tests.	206	70	33.9	60	29.1	76	36.9
9	Mathematics makes me feel nervous.	206	56	27.2	48	23.3	102	49.5
6	I worry about my ability to solve math problems	207	51	24.6	57	27.5	99	47.8

(continue)

Table 14 continued

#	Items	*n*	Very true to Mostly true *f*	Very true to Mostly true %	Moderately true *f*	Moderately true %	Slightly true to Not true *f*	Slightly true to Not true %
4	My mind goes blank and I am unable to think clearly when doing my math test	207	49	23.6	47	22.7	111	53.6
7	I get a sinking feeling when I try to do math problems.	207	43	20.8	56	27.1	108	52.5
11	Mathematics makes me feel uneasy.	206	42	20.4	54	26.2	110	53.4
14	Mathematics makes me feel confused.	207	40	19.3	46	22.2	121	58.4

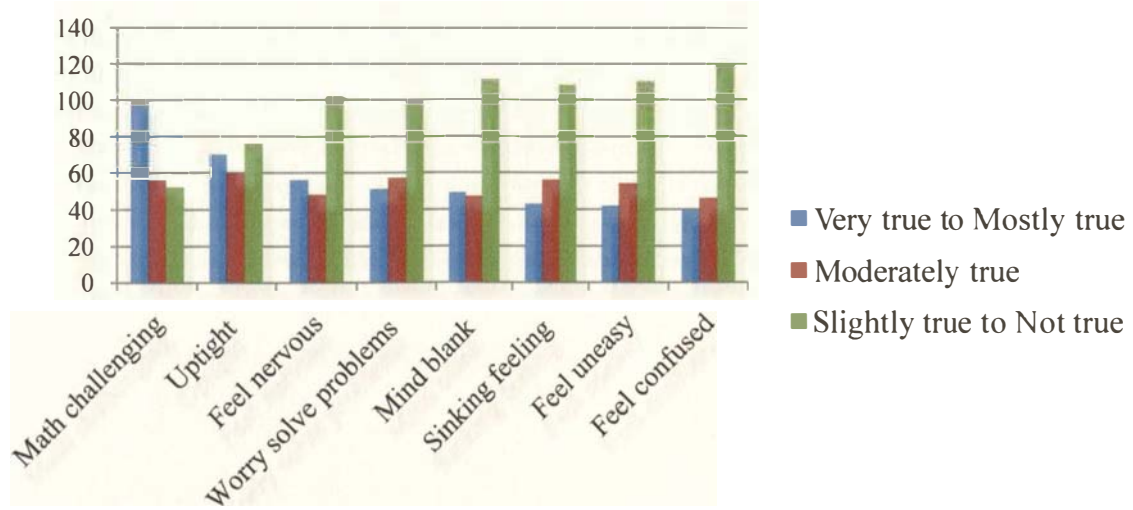

Figure 12. Frequencies of responses to the negative affect items.

The domain mean scores were calculated by adding the responses for each item and dividing by the number of items within the domain. The mean scores and standard deviations for Positive Affect, Negative Affect are displayed in the following table.

Table 15

Means and Standard Deviations of Math Anxiety Scale (MAS –R) Domain Scores

Domain	*n*	*M*	*SD*
Positive Affect	205	3.12	0.92
Negative Affect	204	2.68	1.10

The mean scores for the Positive Affect and Negative Affect were used as cut points to determine group membership for caregivers who expressed positive or negative attitudes towards mathematics. Caregivers with Positive Affect scores at or above the mean were grouped as High Positive ($n = 58$). Caregivers with Negative Affect scores at or above the mean were grouped as High Negative ($n = 55$). However, since there was an independent score for each domain, a large number of participants expressed combinations of high and low Positive Affect and Negative Affect. This resulted in the creation of a Mixed Affect group ($n = 75$).

Summary for Research Question One

Math Anxiety Scale-Revised (MAS-R) measures math anxiety in two domains, Positive Affect and Negative Affect. Caregivers demonstrated both positive and negative feelings related to math anxiety. The mean scores of Positive Affect and Negative Affect

were used to sort caregivers into three groups, High Positive Affect, High Negative Affect and Mixed Affect.

Knowledge of Mathematical Development

The Knowledge of Mathematical Development (KMD) (Platas, 2008) measured the caregivers' knowledge of children's mathematical skills in numbers and operations. Completed surveys were returned by 207 caregivers.

Reliability for the KMD was calculated using inter-item correlation. The Cronbach's alpha value was 0.88. This compared favorably with the reliability reported by the author (Platas, 2008).

Research Question Two: What do Preschool Caregivers Know about Mathematical Development?

Caregivers were instructed to select the skill that children learned first from two statements. If the skills were equally easy for young children, caregivers were to check the box next to "Same" or if they did not know to check "Do not know." The responses were coded to reflect the correct answer, based on the recommendations of the author of the instrument (Platas, 2008). Responses of "Same" and "Do not know" were coded as incorrect. A total KMD score was calculated for each caregiver by adding the number of correct responses. The total KMD score was 11.02 with a standard deviation of 4.30. This indicates that the average caregiver identified the correct answer for 11 of the 20 items. Table 16 reflects the correct answer, with frequencies and percentages reported for correct and incorrect responses to each item. The items are arranged in order from highest to lowest frequencies of correct responses.

Table 16

Frequencies and Percentages of Responses to Knowledge of Mathematical Development

Item Number	Correct Response to Item		Correct		Incorrect	
		n	*f*	%	*f*	%
KMD 12	Kaiden says the counting words in order from 1 to 6.	206	169	82.0	37	18.0
KMD 3	Pauli counts a touchable group of seven buttons.	207	167	80.7	40	19.3
KMD 2	Jamie says the counting words in order from 1 to 10.	207	164	79.2	43	20.8
KMD 20	Daevon recognizes one digit numerals.	207	152	73.4	55	26.6
KMD 8	Micah says the counting words in order from 1 to 6.	206	148	71.8	58	28.2
KMD 1	Sam says the counting words in order from 1 to 10.	206	147	71.0	59	28.6
KMD 5	Ali counts a row of eight teddy bears.	207	137	66.2	70	33.8
KMD 17	Justin recognizes one digit numerals.	207	125	60.4	82	39.6
KMD 6	Shea answers the question "Here are two groups of teddy bears. How many all together?" When presented with two groups of teddy bears.	205	117	56.5	88	42.9
KMD 7	Jaiden counts a row of six buttons.	207	108	52.4	99	47.8
KMD 11	Pilar counts a row of seven buttons.	206	108	52.4	98	47.6

(continue)

Table 16 continued

Item Number	Correct Response to Item		Correct		Incorrect	
		n	*f*	%	*f*	%
KMD 16	Sage counts a row of seven buttons.	206	108	52.4	98	47.6
KMD 18	In a line of five toy sheep facing the same direction, Indigo answers the question, "Point to the first sheep in line."	205	107	52.2	98	47.8
KMD 19	Peyton counts a row of 8 buttons (not in a row).	206	107	51.9	99	48.1
KMD 13	Amari is presented with two groups of buttons, one with five buttons and one with two buttons. When asked "How many altogether?" in the two groups, Amari counts all of the buttons beginning with the group of five buttons.	202	95	45.9	107	53.0
KMD 15	Kim divides twelve cookies between two puppets equally.	203	95	45.9	108	53.2
KMD 10	Cyprus answers the question, "What is five plus one?"	206	65	31.4	141	68.1
KMD 9	Cimarron says the counting words in order from 1 to 10.	206	46	22.3	160	77.7
KMD 4	Angel matches seven forks in one-to-one correspondence with seven plates.	207	46	22.2	161	77.8
KMD 14	Teagan answers the following addition question: "If you have these five cookies and I give you two more, how many cookies will you have altogether?"	204	24	11.8	180	88.2

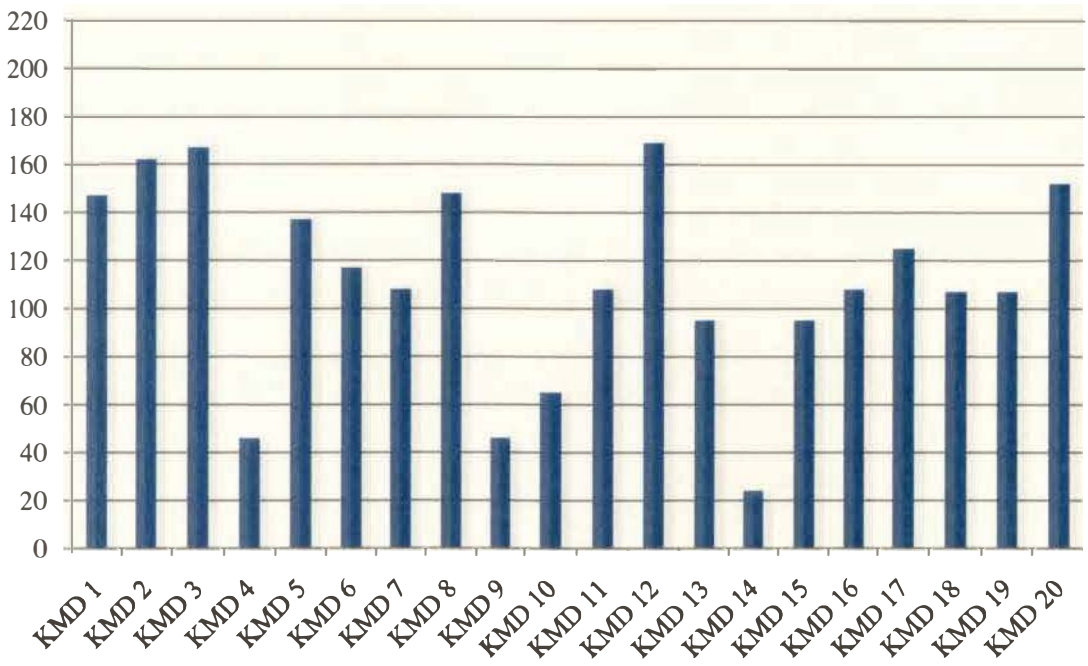

Figure 13. Frequencies of caregivers' correct responses for Knowledge of Mathematical Development.

Patterns of incorrect responses were noted. From 22% to 45% of the caregivers selected "Same" for nine of the 20 items. More than 20% of the caregivers selected "Do not know" for four of the items. Results in Table 17 reflect that many caregivers were unsure about the process of preschool children developing math skills.

Table 17

High Frequencies and Percentages of Responses either "Same" or "Do Not Know"

Item number	Same			Did Not Know	
	n	*f*	%	*f*	%
KMD 10	205	92	44.7		
KMD 9	206	88	42.7		
KMD 11	206	88	42.7		
KMD 16	206	75	35.0		
KMD 7	207	71	34.4		
KMD 19	206	68	33.0		
KMD 18	205	66	32.2		
KMD 14	204	59	28.9	46	22.5
KMD 15	203	45	22.2	48	23.6
KMD 6	205			46	22.4
KMD 13	202			43	21.3

Summary for Research Question Two

The Knowledge of Development of Mathematics scores showed that preschool caregivers were able to identify the correct sequence of early math development in 55% of the items. Caregivers' responses reflected that they identified that math development happened at the "Same" time or "Do not know" in 11 of the items.

Beliefs about Mathematics Teaching and Learning in the Preschool Classroom

The Beliefs (Platas, 2008) survey about preschool mathematics curriculum consists of 40 statements with the following ratings: Strongly Agree (6); Agree (5);

Somewhat Agree (4); Somewhat Disagree (3); Disagree (2); and Strongly Disagree (1). The items were grouped into four subscales, based on the recommendations of the author of the instrument. These included "Classroom Locus of Generation of Mathematical Knowledge," "Age-Appropriateness of Math Instruction," "Social and Emotional vs. Mathematical Development as Primary Goal of Preschool," and "Teacher Comfort in Mathematics Instruction."

Research Question Three: What are Preschool Caregivers' Beliefs about Mathematics Teaching and Learning in the Preschool Classroom?

Scores for the subscales were created by adding the item ratings in each subscale and dividing by the number of items. The subscale mean scores are presented in the following table.

Table 18

Means and Standard Deviations for the Beliefs Subscales Scores

Scale	*n*	*M*	*SD*
Locus subscale	193	3.65	0.65
Age appropriateness	199	4.90	0.78
Goals	201	4.93	0.64
Comfort	194	4.94	0.80

Beliefs about Mathematics Teaching and Learning in the Preschool Classroom Survey

The beliefs survey's Cronbach's Alpha for the whole scale was 0.918 for the 40 questions. This was higher than the Cronbach's alpha of 0.83 to 0.93 reported by the

author. The Cronbach's alpha subscales for Locus was 0. 705; Age appropriate was 0.888; for Goals 0.777 and for Comfort 0.910. Caregivers' beliefs about children math were divided into three sections defined as: The Agree identification was from the "strongly agreed and agreed" responses; the Somewhat Agree came from the "slightly agreed and somewhat disagree" responses; with Disagree identified as responses in the "disagreed and strongly disagreed" responses. Questions were sorted into the four categories designated in the Beliefs about Mathematics Teaching and Learning in the Preschool Classroom tool and from highest frequency of agreement to disagreement. Questions were then sorted according to the highest agree frequencies. The results are reflected in the following table and figure.

Table 19

Frequencies and Percentages of Classroom Locus of Generation of Mathematical Knowledge Subscale

#	Item		Agree		Somewhat Agree		Disagree	
		n	*f*	%	*f*	%	*f*	%
18	Teachers can help preschoolers learn mathematics.	207	184	88.8	21	10.1	2	1.0
10	The teacher should play a central role in preschool mathematics activities.	207	165	79.7	37	17.8	5	2.4
36	Teachers should show preschoolers the correct way of doing mathematics.	205	118	57.6	66	32.2	21	10.2
13	Preschoolers learn mathematics best through direct teaching of basic skills.	202	101	50.0	71	35.1	30	14.9

(continue)

Table 19 continued

#	Item		Agree		Somewhat Agree		Disagree	
		n	*f*	%	*f*	%	*f*	%
18	Teachers can help preschoolers learn mathematics.	207	184	88.8	21	10.1	2	1.0
8	Preschoolers learn mathematics *without* support from teachers.	206	101	49.1	78	37.9	27	13.1
38	Before kindergarten, preschool teachers should make sure preschoolers memorize verbal counting numbers.	205	91	44.4	62	30.2	52	25.4
23	In preschool, children construct their mathematical knowledge *without* the help of a teacher.	204	85	41.6	93	45.6	26	12.7
6	Math flashcards are appropriate for preschoolers.	206	62	30.1	87	42.2	57	27.7
19	In preschool, children should learn *specific* procedures for solving math problems (i.e., 2 + 4).	206	45	20.9	80	38.8	83	40.3
32	Preschool teachers are responsible for making sure that preschoolers can learn the right answer in mathematics.	204	37	18.1	84	41.1	83	40.7
25	Teachers should help preschool children memorize number facts (for instance, 2 +3).	205	25	12.2	73	35.6	107	52.5
33	Math worksheets are appropriate for preschoolers.	206	25	12.1	58	28.2	123	59.7

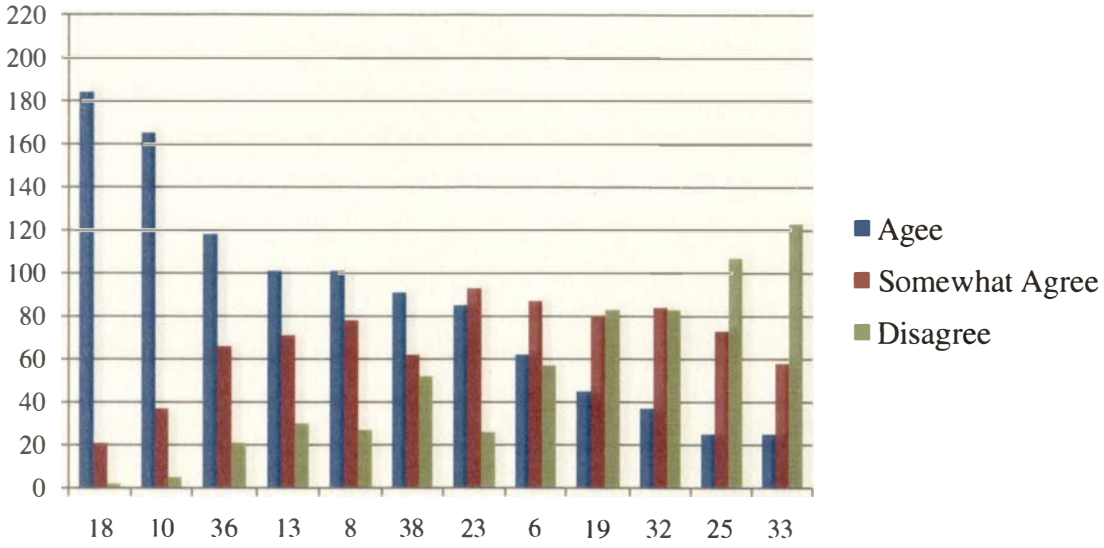

Figure 14. Frequencies of items in Locus of Generation of Mathematical Knowledge subscale.

Table 20

Frequencies and Percentages of Age-Appropriateness of Mathematical Instruction Subscale

#	Item		Agree		Somewhat Agree		Disagree	
		n	*f*	%	*f*	%	*f*	%
4	Preschoolers are capable of learning math.	207	186	89.9	16	7.7	5	2.4
3	Mathematical activities are an inappropriate use of time for preschoolers; because they aren't ready for them.	207	175	84.6	24	11.6	8	3.8
2	It is better to wait until kindergarten for math activities.	207	170	82.2	28	13.5	9	4.3

(continue)

Table 20 continued

#	Item		Agree		Somewhat Agree		Disagree	
		n	*f*	%	*f*	%	*f*	%
39	Math is a worthwhile and necessary subject for preschoolers.	206	161	78.2	41	19.9	4	2.0
22	Children are ready for math activities in preschool.	205	150	73.1	50	24.3	5	2.5
31	Academic subjects such as mathematics are too advanced for preschoolers.	204	149	73.0	48	23.5	7	3.5
35	Mathematical activities are age-appropriate for preschoolers.	206	148	71.9	44	21.4	14	6.8
15	Most preschoolers are ready for participation in math activities.	206	132	64.0	66	32.1	8	3.9
29	Math is confusing to preschoolers.	205	124	60.5	73	35.6	8	4.0
37	Very *few* preschoolers are ready for math in preschool.	205	115	56.1	69	33.7	21	10.2

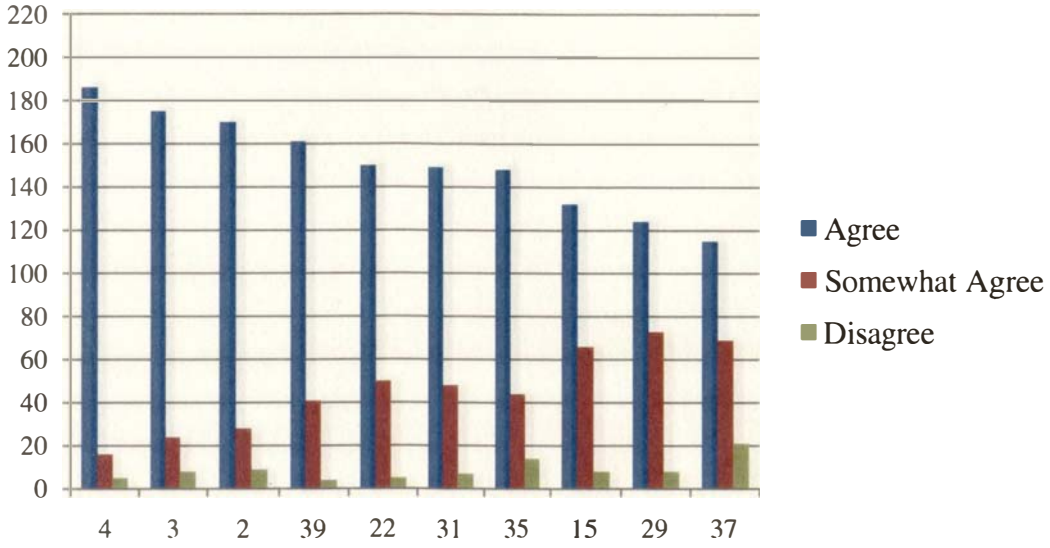

Figure 15. Frequencies of Age-Appropriateness of Mathematical Instruction subscale.

Table 21

Frequencies and Percentages of Social and Emotional versus Mathematical Development as Primary Goals Subscale

#	Item		Agree		Somewhat Agree		Disagree	
		n	*f*	%	*f*	%	*f*	%
1	Math is an important part of the preschool curriculum.	204	190	92.5	13	6.4	3	1.5
9	Math activities are a very important part of the preschool experience.	207	177	85.5	26	12.5	4	2.0
20	Preschool math will weaken preschoolers' self confidence.	206	165	80.1	31	15.1	10	4.8

(continue)

Table 21 continued

#	Item		Agree		Somewhat Agree		Disagree	
		n	*f*	%	*f*	%	*f*	%
28	If a preschool teacher spends time in math activities in the classroom, social and emotional development will be neglected.	206	164	79.7	38	18.5	4	2.0
7	Math activities are good opportunities to develop social skills in preschool.	206	162	78.7	38	18.4	6	3.0
26	Preschool children are *not* socially or emotionally ready for math activities.	206	153	74.3	44	21.4	9	4.4
16	Social and emotional development is the *primary* goal of preschool and time spent on math takes away from this goal.	205	115	56.1	73	35.7	17	8.3
12	Supporting development in academic subjects such as math is the *primary* goal of preschool education.	206	91	44.1	90	43.7	25	12.1

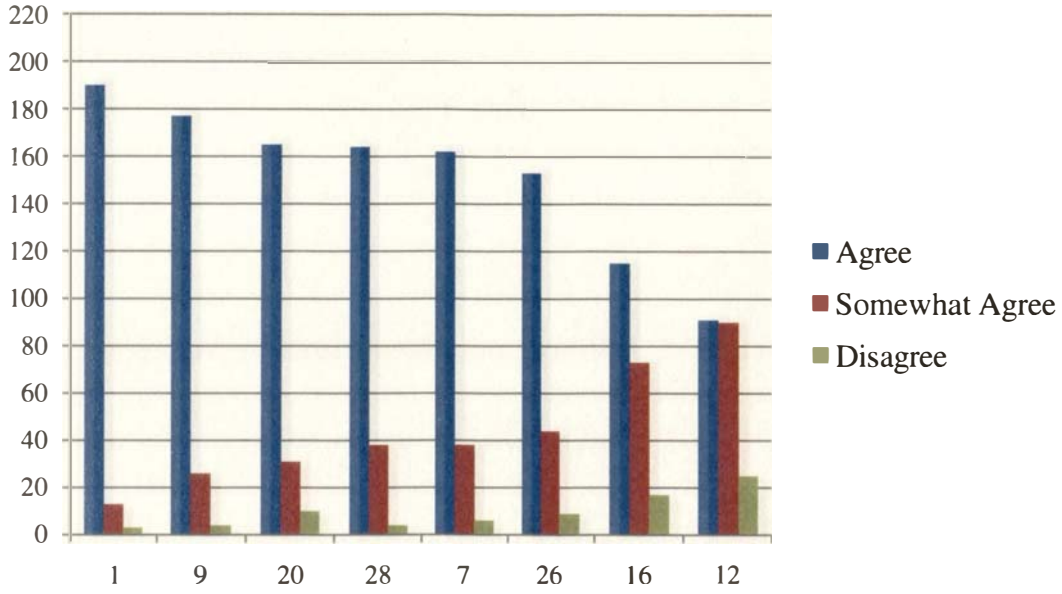

Figure 16. Frequencies of Social and Emotional versus Mathematical Development as Primary Goals subscale.

Table 22

Frequencies and Percentages of Teacher Comfort in Mathematics Instruction Subscale

#	Item		Agree		Somewhat		Disagree	
		n	*f*	%	*f*	%	*f*	%
24	I don't know enough math to teach it in preschool.	206	170	82.5	29	14.1	7	3.4
5	I am knowledgeable enough to teach math in preschool.	207	155	74.9	47	22.7	5	2.4
17	Math is/would be a difficult subject for me to teach in preschool.	204	154	75.5	45	22.1	5	2.5

(continue)

Table 22 continued

#	Item		Agree		Somewhat		Disagree	
		n	*f*	%	*f*	%	*f*	%
27	Math would be easy for me to incorporate into preschool curricula.	207	154	74.4	46	22.2	7	3.3
34	I don't know how to teach math to preschoolers.	206	153	74.2	48	23.3	5	2.4
11	Teaching mathematics to preschoolers is/would be uncomfortable for me.	207	149	72.0	35	16.9	23	11.1
30	I can create effective math activities for preschoolers.	206	146	70.8	53	25.7	7	3.4
21	I can think of many math activities that would be appropriate for preschoolers.	206	145	69.9	53	25.6	9	4.4
14	I am unsure how to support math development for young children.	206	138	67.0	57	27.7	11	5.4
40	I know how to support math learning in preschool.	199	133	66.8	56	28.1	10	5.0

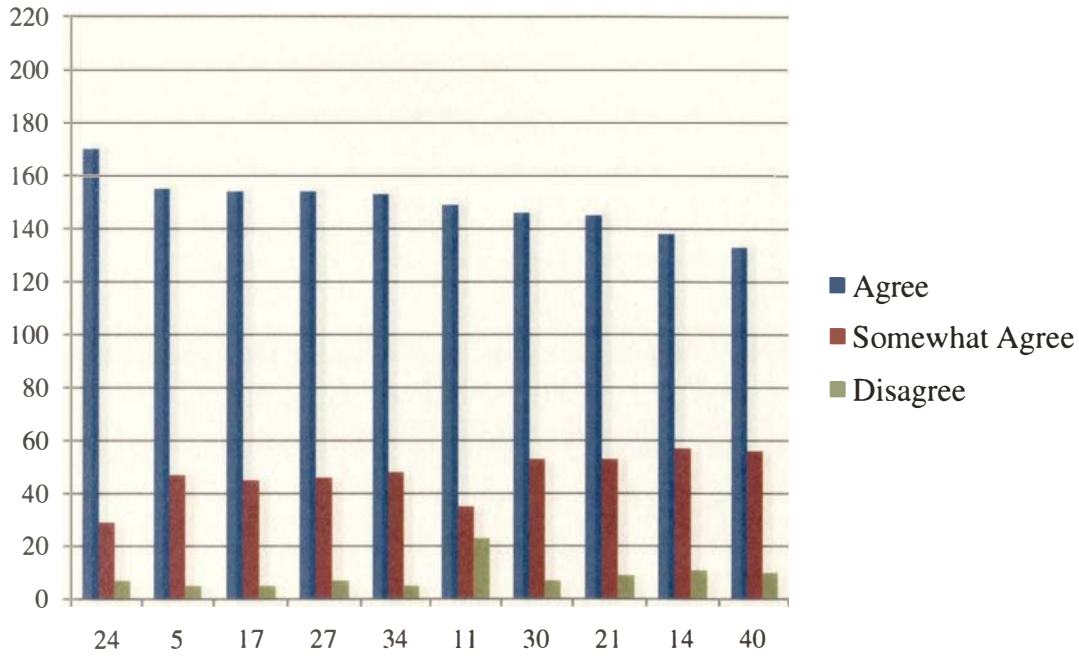

Figure 17. Frequencies of Teacher Comfort in Mathematics Instruction subscale.

In the area of locus of control the caregivers highest agreement was that "teachers can help preschoolers learn mathematics, and should play a central role in preschool mathematics activities" with highest disagreement about "teachers should help preschool children memorize number facts and worksheets are appropriate for preschoolers." The subscale of Age appropriateness caregivers' responses consisted of high agreement in the concept that "preschoolers are capable of learning math, and mathematical activities are an inappropriate use of time for preschoolers; because they aren't ready for them" and highest disagreement is that "math is confusing to preschoolers, and very few preschoolers are ready for math in preschool." The subscale of social and emotional versus mathematical development as primary goals indicated that caregivers' high agreement from "math is an important part of the preschool curriculum and math

activities are very important part of the preschool experience, preschool math will weaken preschoolers' self confidence" with low agreement on "social and emotional development is the primary goal of preschool and time spent on math takes away from this goal and supporting development in academic subjects such as math is the primary goal of preschool education." The subscale of teacher comfort in mathematics instruction elicited responses in the highest agreement as "that the participant said not know enough math to teach it in preschool and that they are knowledgeable enough to teach math in preschool with math is would be a difficult subject for me to teach in preschool and math would be easy for me to incorporate into preschool criteria." The lowest agreement was on "I am unsure how to support math development for young children and I know how to support math learning in preschool."

Scores for the subscales were created by adding the item ratings in each subscale and dividing by the number of items. Higher scores indicate higher agreement with the subscale. High score is teacher as locus; high score is age-appropriate; high score is mathematical development more important; high score is very comfortable with classroom support to mathematical development. (Platas, 2008). The subscale mean scores are presented in the following table.

Table 23

Subscales of Beliefs

Sub-title	*n*	*M*	*SD*
Locus of Generation of Mathematical Knowledge	193	3.852	0.65
Age-Appropriateness of Mathematical Instruction	199	4.909	0.78
Social and Emotional versus Mathematical Development as Primary Goals	201	4.938	0.64
Teacher Comfort in Mathematics Instruction	194	4.938	0.80

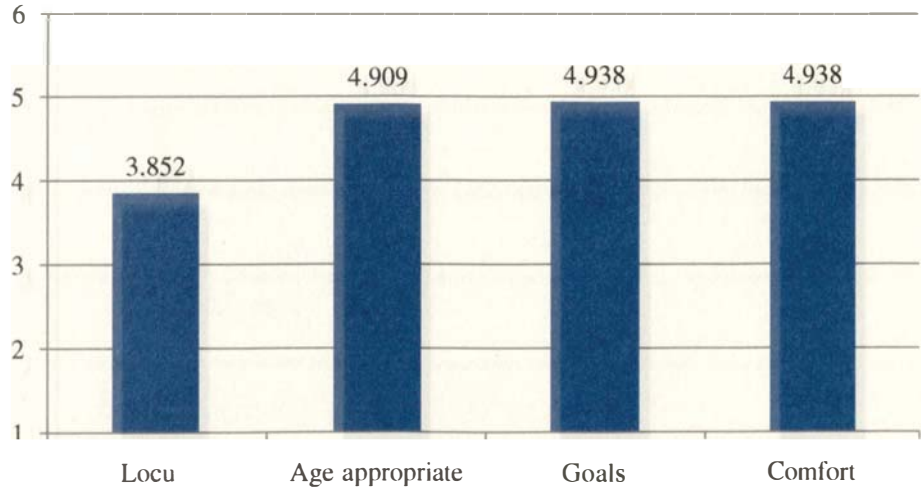

Figure 18. Beliefs subscales means.

Summary for Research Question Three

Preschool caregivers' beliefs about mathematics teaching and learning in the preschool classroom demonstrated strong agreement that mathematics activities were age

appropriate. Caregivers also strongly agreed that mathematics were an important goal of the preschool curriculum. In addition, caregivers agreed that they were knowledgeable and comfortable with teaching math in preschool. The findings indicated that caregivers believed that they should play a central role in teaching mathematics to preschoolers.

Correlations

Research Question Four: Are there Correlations between Knowledge of Mathematical Development (KMD) and Beliefs about Mathematics Teaching and Learning in the Preschool Classroom?

Pearson-product moment correlations were calculated to determine relationships between the Knowledge of Mathematical Development (KMD) total scores and the Beliefs subscale mean scores. The results are displayed in Table 24.

Table 24

Correlations between KMD Total Scores and Beliefs Subscales Mean Scores

Beliefs Subscales	KMD Total Score		
	n	*r*	*p*
Locus of Generation of Mathematical Knowledge	181	-0.19	0.009**
Age Appropriateness of Mathematics Instruction in the Early Childhood Classroom	185	0.25	0.001***
Social and Emotional versus Mathematical Development as Primary Goal of Preschool	188	0.18	0.013*
Teacher Comfort in Mathematics Instruction	181	0.22	0.002**

*p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001

KMD Total Scores were positively correlated with Age Appropriateness of Mathematics Instruction, Social and Emotional versus Mathematical Development as Primary Goal of Preschool, and Teacher Comfort in Mathematics Instruction. These correlations were statistically significant. This indicated that caregivers who attained higher scores on knowledge of children's mathematical development tended to support the Age Appropriateness, Mathematical Development Goals, and Teacher Comfort dimensions of the Beliefs survey. The negative correlation of KMD with Locus reflected a movement from the Teacher as Locus of Control toward the Child as Locus of Control in the classroom as caregivers selected more correct items in the Knowledge of Mathematical Development.

Summary for Research Question Four

The knowledge of mathematical development and beliefs about mathematical teaching and learning in the preschool classroom showed significant interaction in a positive way with Age Appropriateness of Mathematics Instruction, Social and Emotional versus Mathematical Development as Primary Goal of Preschool, and Teacher Comfort in Mathematics Instruction beliefs subscales and a negative correlation with the Locus of Generation of Mathematical Knowledge subscale.

Comparisons of Knowledge of Mathematical Development by Mathematics Anxiety Groups

Research Question Five: Are there Differences in Mean Knowledge of Mathematical Development (KMD) Scores When Caregivers are Grouped by Math Anxiety Scale-Revised (MAS-R) Scores?

The KMD total score measured the caregivers' knowledge of children's mathematical development. Math Anxiety scores were used to classify caregivers into three groups. These included High Positive Affect, High Negative Affect, and Mixed Affect scores. An analysis of variance was calculated to compare the KMD total mean scores of the three groups. The results are displayed in the following table.

Table 25

KMD Total Scores by Math Anxiety Groups

Groups	*n*	*M*	*SD*	*F*	*P*
High Positive Affect	57	11.12	4.20	0.46	0.96
High Negative Affect	58	11.10	4.23		
Mixed Affect	74	10.92	4.40		

The caregivers grouped by Math Anxiety scores did not differ significantly when knowledge of children's mathematical development was measured. Those in the High Positive Affect group tended to have the highest number of correct responses on the KMD survey, while the Mixed Affect group scored lowest.

Summary for Research Question Five

Caregivers grouped by Math Anxiety scores did not differ significantly when knowledge of children's mathematical development was measured. Those in the High Positive Affect group tended to have the highest number of correct responses on the KMD survey, while the Mixed Affect group scored lowest.

Comparisons of Beliefs Subscales by Math Anxiety Groups

Research Question Six: Are there Differences in the Four Beliefs about Mathematical Teaching and Learning in the Preschool Classroom Subscales Scores when Caregivers are Grouped by Math Anxiety Scale-Revised (MAS-R) Scores?

The Beliefs survey consists of four subscales that reflected caregivers' perceptions regarding Locus of Generation of Mathematical Knowledge, Age Appropriateness of Mathematics Instruction, Social and Emotional versus Mathematical Development as Primary Goal of Preschool, and Teacher Comfort in Mathematics Instruction. A multivariate analysis of variance was selected to compare differences in group means. As a preliminary measure, the four subscales were correlated to determine correlations among the dependent variables. The correlations are displayed in the following table. Locus of Control did not correlate with the three other subscales.

Table 26

Correlations of Beliefs Subscales

	Locus			Age Approp			Goals			Teacher Comfort		
	n	*r*	*p*	*n*	*r*	*p*	*n*	*r*	*p*	*n*	*r*	*p*
Locus	193	1.00	0.00	190	0.06	0.40	192	0.08	0.27	186	0.07	0.35
Age Approp					1.00		197	0.80	0.00	189	0.71	0.00
Goals								1.00		192	0.63	0.000
Comfort											1.00	

Based on these findings, a separate ANOVA was calculated for Locus of Control. The caregivers did not differ significantly in Locus of Control when compared by Math Anxiety groups. Table 27 displays the results.

Table 27.

Locus of Control Subscale by Math Anxiety Groups

Groups	*n*	*M*	*SD*	*F*	*P*
High Positive Affect	58	3.93	0.71	0.94	0.39
High Negative Affect	55	3.77	0.62		
Mixed Affect	75	3.86	0.63		

The groups did not differ significantly when comparing Locus subscale scores. The High Positive Affect group evidenced a higher score in the Locus subscale, indicating a more teacher-centered locus of control.

The three correlated subscales were subsequently entered into a MANOVA procedure. A Wilk's Lambda value of 0.94 had an associated F value of 1.91, $p = 0.08$. The groups did not differ significantly when comparing the set of mean scores of the subscales Age Appropriateness, Mathematical Developmental Goals, and Teacher Comfort. Follow-up ANOVAs and post hoc tests revealed a consistent pattern in the groups' scores.

Table 28

Means and Standard Deviations of Three of the Beliefs Subscales by Math Anxiety Groups

Subscales	Groups	*n*	*M*	*SD*	*F*	*P*
Age Appropriateness	High Positive	54	5.17	0.66	4.50	0.12
	High Negative	55	4.75	0.78		
	Mixed	74	4.87	0.80		
Mathematical Goals	High Positive	54	5.15	0.51	4.50	0.12
	High Negative	55	4.81	0.70		
	Mixed	74	4.88	0.65		
Teacher Comfort	High Positive	54	5.21	0.74	4.58	0.12
	High Negative	55	4.78	0.75		
	Mixed	74	4.87	0.86		

The High Positive Affect group scored highest, followed by the Mixed Affect group. The High Negative Affect group scored the lowest in the three Beliefs subscales. The scores of the High Positive Affect group and High Negative Affect group were the most dissimilar.

Summary for Research Question Six

The beliefs about mathematics teaching and learning in the preschool classroom and according to the subscales of Locus of Generation of Mathematical Knowledge, Age Appropriateness of Mathematics Instruction, Social and Emotional versus Mathematical Development as Primary Goal of Preschool, and Teacher Comfort in Mathematics subscales tended to follow the pattern that High Positive Affect group scored highest, followed by the Mixed Affect group. The High Negative Affect group scored the lowest in the three Beliefs subscales. The scores of the High Positive Affect group and High Negative Affect group were the most dissimilar.

Summary

The research questions were addressed in this chapter. Results were described in tables and graphs. The measure of math anxiety revealed that preschool caregivers reported both high positive affect (31%) and high negative affect (29%) and a group with mixed affect anxiety (40%). The measure of knowledge of children's mathematical development (KMD) revealed that preschool caregivers selected the correct response in 11 out of 20 items. The measure of Beliefs indicated that caregivers reported positive agreement with comfort, goals, and age appropriateness, with a more moderate agreement that the teacher should serve as the locus of control in the classroom.

Knowledge of Mathematical Development and Beliefs about Mathematical Teaching and Learning in the Preschool Classroom were positively correlated. When the caregivers were grouped by levels of math anxiety, they were not found to be significantly different in their knowledge or beliefs.

CHAPTER V

DISCUSSION

The descriptive study investigated preschool caregivers' mathematical anxiety, their knowledge of mathematics for young children in the areas of numbers and operations and their beliefs about mathematical curriculum for young children. There is research on math anxiety of elementary teachers and curriculum designed to support the instruction for elementary children (Akinsola, 2008; Hachey, 2009; Jackson & Leffingwell, 1999; Vinson, 2001). This study was conducted with the specific goal of exploring preschool caregivers' anxiety about mathematics for children ages three to five years and to determine whether math anxiety was related to caregivers' knowledge and beliefs.

The study was conducted in Bell and Coryell Counties in Central Texas during the fall of 2010. Invitations to allow students and employees to participate were extended to the administrators of Central Texas College and Temple College, Fort Hood Military Base Child Development Centers, and local child care programs. All participants met the criteria for inclusion that included a minimum of 15 hours weekly employment with children three to five years of age. Packets containing the consent forms and surveys were delivered to college department chairs and to center directors. Packets were completed by 207 preschool caregivers, representing a 76% return rate.

The Mathematics Anxiety Scale—Revised (MAS-R) (Bai, 2010) measured two domains of math anxiety, Positive Affect and Negative Affect. Knowledge of

Mathematical Development (KMD) (Platas, 2008) measured caregivers' knowledge of children's mathematical development in numbers and operations. Beliefs about Mathematical Teaching and Learning in the Preschool Classroom (Beliefs) (Platas, 2008) measured caregivers' beliefs with four subscales. These included Classroom Locus of Generation of Mathematical Knowledge, Age-Appropriateness, Social and Emotional versus Mathematical Development as Primary Goal of Preschool and Teacher Comfort in Mathematical Instruction. A demographic questionnaire elicited background information related to caregivers' age, ethnicity, gender, education and training, and descriptions of child care programs.

Findings

The sample of preschool caregivers was predominantly female (99%), with ages ranging from 18 to 60 or older. Approximately one-half of the sample were under age 40, and one-half were older than 40. Ethnicities included 41% Caucasian, 33% African-American, and 20% Hispanic, with the remainder (6%) reported as Asian-American, Native American, and Multiethnic. Education was reported as the highest level completed. Caregivers who had attained a General Educational Development (GED) certificate or high school diploma comprised 23.6% of the sample. Caregivers, who completed some college courses, earned a Child Development Certificate or an Associate's Degree represented 58% of the sample. Those with a Bachelor's Degree comprised 15% of the sample, with 1.9% having attained a Master's Degree. Math courses completed during high school varied widely; college math courses were completed by 53.6% of the caregivers.

Years of teaching experience ranged from one to more than thirty years. The majority were employed as Lead Teachers in preschool classrooms. Child care centers served enrollment capacities from less than 20 to move than 200 children. Caregivers were employed in Head Start, church affiliated, privately owned, military, and corporate, franchise, or municipal programs. Eight of the child care centers were accredited, employing 24% of the caregivers in the sample.

Research Questions

Research conducted for this study answered the questions which are discussed below.

Research Question One. What are the Dimensions of Mathematical Anxiety Expressed by Preschool Caregivers?

The MAS-R (Bai, 2010) produced domain scores for Positive Affect and Negative Affect. Caregivers expressed moderate Positive Affect ($M = 3.12$, $SD = 0.92$) and moderately low Negative Affect ($M = 2.68$, $SD = 1.10$). In the Positive Affect Domain, the majority of caregivers reported that they would use math in the future and that math related to their lives. In the Negative Affect Domain, many caregivers reported that they found math challenging and "get uptight during math tests." Other negative feelings of nervousness, uneasiness, and confusion may partially account for the reluctance of preschool caregivers to enroll in college math courses. This supported the findings of Ashcraft (2002) who suggested that college students with high math anxiety avoid math courses.

Previous research studies suggested that math anxiety tended to be high in female teachers as well as female students (Beilock et al., 2010; Jackson & Leffingwell, 1999). On a five-point scale, the results of the math anxiety measure for preschool caregivers in the current study appeared to be in the moderate rather than high negative range. This was a surprising result.

Further concerns about the math anxieties of teachers were addressed in studies by (Akinsola, 2008; Ashcraft, 2002; Hagedorn, Lester, & Cypers, 2010). Findings indicated that teachers' math anxieties affect the experiences offered to young children. Teachers who are anxious about mathematics may transfer anxiety to children (Beilock et al., 2010; Gresham, 2007).

The statistical analysis of the MAS-R included an unexpected result: a Mixed Affect group. These participants did not express High Positive Affect or High Negative Affect but included a combination of both. This was not a finding reported in the original study conducted by Bai (2010). The largest group in the current study was the Mixed Affect group ($n = 75$).

Research Question Two. What do Preschool Caregivers' Know about Mathematical Development?

The KMD (Platas, 2008) measured caregivers' knowledge of children's development in numbers and operations. Scores were determined by the number of correct responses on 20 items. There was evidence that caregivers' knowledge of mathematical development was somewhat limited. Only 55% of the caregivers correctly

responded to 11 items. The low KMD total scores indicated that preschool caregivers were unsure about the order of mathematical development for young children.

Platas's (2008) administered the KMD to three cohorts that included pre-service college students and no teaching experience, or some college with two years experience, or enrolled in a master's programs with more than one year experience. The KDM total mean scores for the current sample of preschool caregivers were most similar to the pre-service college students studied by Platas (2008).

Both mathematical content and processes are emphasized in the National Council for Teachers of Mathematics Standards (National Council for Teachers of Mathematics, 2002). Without a firm foundation in the developmental order of children's mathematical development, caregivers may be ill-equipped to support children's learning. The findings support the recommendations from the NAEYC and NCTM Position Statement that encourage more effective teacher preparation and professional development in mathematics (NAEYC & NCTM, Early Childhood Mathematics: Promoting Good Beginnings, 2002).

Research Question Three. What are Preschool Caregivers' Beliefs about Mathematics Teaching and Learning in the Preschool Classroom?

The Beliefs subscales measured preschool caregivers' agreement with four components of mathematics curriculum. The mean scores for Age-Appropriateness, Social and Emotional versus Mathematical Development as Primary Goal of Preschool and Teacher Comfort in Mathematical Instruction were consistently M=4.9 on a 6 point scale. These indicated strong agreement regarding the importance of mathematics

activities in preschool classrooms. The mean scores for Classroom Locus of Generation of Mathematical Knowledge was M=3.9, reflecting that the teacher played a critical role in the teaching of mathematics.

The findings from the current study revealed that the Beliefs subscale mean scores of preschool caregivers in Age-Appropriateness, Social and Emotional versus Mathematical Development as Primary Goal of Preschool, and Teacher Comfort in Mathematical Instruction were similar to the scores of the master's degree cohort in the study conducted by Platas (2008). The subscale scores in Classroom Locus of Generation of Mathematical Knowledge were most like the pre-service teachers with no experience.

Beliefs about mathematics curriculum for young children probably influences the experiences that caregivers provide in their classrooms. Recommendations for practitioners from Epstein (2007) emphasize the importance of surrounding the children with a number rich environment. Recommendation were also made that a rich vocabulary and problem solving enrironment should be created for children to explore and develop math ideas using hands-on materials (Copple & Bredekamp, 2009; Epstein, 2007; Graham, Nash, & Kim, 1997). Mathematical experience with the support of intentional teaching is connected to teachers' knowledge on how to structure information and solve problems (Copley, 2010; Smith, 2009). The caregiver's role is to provide a setting that is designed to allow preschool children to solve problems. Caregivers should equip their classrooms to support preschool children's exploration and experimentation with many math concepts (Copley, 2010).

Research Question Four. Are there Correlations between Knowledge of Mathematical Development (KMD) and Beliefs about Mathematics Teaching and Learning in the Preschool Classroom?

KMD Total scores were positively and significantly correlated with the Beliefs subscales of Age-Appropriateness, Social and Emotional versus Mathematical Development as Primary Goal of Preschool and Teacher Comfort in Mathematical Instruction. There was a significant negative correlation with the Beliefs subscale Classroom Locus of Generation of Mathematical Knowledge. Caregivers with higher scores on knowledge of mathematical development tended to endorse preschool mathematics curriculum. The negative correlation between Classroom Locus of Generation of Mathematical Knowledge and KMD may be indicative that preschool caregivers with lower knowledge scores tended toward more teacher-centered approaches.

The correlations evidenced in the current study were somewhat lower but similar to the findings reported by Platas (2008). In addition, the results supported the recommendations of Balfanz (1999) who suggested a relationship between quality mathematical instruction and teachers' beliefs about mathematical instruction in the classroom (Copley, 2010; Copple & Bredekamp, 2009).

Research Question Five. Are there Differences in Mean Knowledge of Mathematical Development (KMD) Scores when Caregivers are Grouped by Math Anxiety Scale-Revised (MAS-R) Scores?

The KMD measured preschool caregivers' knowledge of development of mathematics. The MAS-R grouped caregivers into High Positive Affect, High Negative Affect and Mixed Affect. Caregivers' KMD scores did not differ significantly when group means were compared. There appeared to be a pattern: the High Positive Affect group tended to have the highest number of correct responses on the KMD survey, while the Mixed Affect group scored lowest.

Research Question Six. Are there Differences in the Four Beliefs about Mathematics Teaching and Learning in the Preschool Classroom Subscales Scores when Caregivers are Grouped by Math Anxiety Scale-Revised (MAS-R) Scores?

The Beliefs survey was comprised of four subscales including Classroom Locus of Generation of Mathematical Knowledge, Age-Appropriateness, Social and Emotional versus Mathematical Development as Primary Goal of Preschool and Teacher Comfort in Mathematical Instruction. An analysis of variance test compared the Classroom Locus of Generation of Mathematical Knowledge mean scores by the three groups determined by math anxiety scores. The groups did not differ significantly. The three correlated Beliefs subscales were combined in a MANOVA test to compare groups by math anxiety. The groups did not differ significantly. For each of the Beliefs subscales, The High Positive Affect group scored highest, followed by The Mixed Affect group. The High Negative

Affect group scored the lowest in the three Beliefs subscales. The scores of the High Positive Affect group and High Negative Affect group were the most dissimilar.

Conclusions

The conclusions from this study are:

1. The preschool caregivers expressed mixed anxiety about mathematics.
2. Forty-five percent of the preschool caregivers could not correctly identify the order in which young children learn numbers and operations.
3. Preschool caregivers agreed that mathematics is age appropriate, an important goal in preschool classrooms, and that they were comfortable with mathematics curriculum.
4. KMD and Beliefs were related.
5. Mean scores for KMD and Beliefs subscales did not differ significantly when preschool caregivers were grouped by Math Anxiety (High Positive Affect, High Negative Affect, and Mixed Affect).
6. Preschool caregivers need specific mathematical education and professional development along with programs that support the need for materials and opportunities to enrich math language and experiences for young children. Communities for young children can meet these needs with local support. A belief that mathematics is a core of children's learning is a place to start.
7. Standards for preschool children recommend that child caregivers create environments and experiences for young children to develop mathematics skills.

Policies need to reflect and require education and professional development as a support to these standards.

6. The public education system may need to reexamine the practices of teaching mathematics within all educational systems, from childcare through college experiences. Reevaluation of how math anxiety is addressed as part of the math curriculum would be a good place to start the evaluation. Education systems need to evaluate how mathematics education is offered to help break the cycle of anxiety and concerns about taking teaching mathematics courses.

Limitations

- Preschool caregivers represented only Bell and Coryell Counties in Texas who agreed to participate.
- Respondents were volunteers and may differ from those who did not complete the survey.

Implications

Findings of the current study have a number of implications to child care programs, child development presenters, child development college programs, and child development policy makers. Recognizing and implementing stronger caregiver training and educational opportunities in the area of mathematics is essential to support the creation of rich, relevant, hands-on opportunities for young children to develop math skills. Training and education needs to address the issues of adult math anxiety and the caregivers' beliefs about including mathematical opportunities in the preschool classroom.

Policies for education can include recommendations for caregivers to participate in mathematical training as an identified specific topic during annual training. Colleges can look at ensuring that a child development mathematics course is part of the degree requirements for Child Development degrees. The course should be constructed so that student outcomes are clearly focusing on the mathematical constructs and processes and not include other areas of study. In Texas math and science for young children are combined into one college course.

Child care programs need to recognize and support the classroom teachers' need for training and materials to implement broader mathematics opportunities for young children. Much of the needed materials are rich opportunities to encourage children to explore and evaluate existing experiences in new ways. Caregivers will need time and practice to incorporate new mathematical ideas into their existing schedule. Peer mentoring and support opportunities will be essential in the caregivers' development of mathematics in the classroom.

In the publication *Children of 2020* Sarama and Clements (2010) writes a chapter: The Mathematical Lives of Young Children in which they say, "Hope for the children of 2020—that the children of 2020 are provided the chance to have rich, engaging, opportunities to learn how to make sense of their world by seeing it through mathematical lenses" (Sarama & Clements, 2010, p. 84). Educating caregivers today and in the future is an essential component to making that hope become a reality.

Recommendations for Future Study

For Policy

Further studies need to be done on how to include math as a specific area of consideration in quality programs for young children. NCTM standards define what is needed to support and implement the needed practices. Methods to ensure that these standards are implemented and assessed are also needed. This assessment should be both the classroom activities and the expanding understanding of the children in the classroom through observational assessments.

College course work in mathematics at the developmental level, college related math courses, and child development math courses should consider the students anxiety as part of the curriculum plan.

For Future Research

There has been limited research done on preschool caregivers in relations to their math anxiety or interactions with young children in math activities. More research based on observational interactions of preschool classrooms of caregivers' daily mathematical interactions is needed. Identification of opportunities is needed that encourage and challenge children in relevant everyday experiences that encourage them to participate in formal and informal math experiences.

The research tools created by Dr. Platas (2008) were important to the current study. The Knowledge of Mathematical Development tool only assesses caregivers' knowledge in the area of numbers and operations. Additional tools to assess caregivers' knowledge in other areas of mathematics for young children could increase opportunities

for research in other areas of caregivers understanding of children's mathematical development. The Beliefs tool developed by Dr. Platas (2008) includes a subscale of Classroom Locus of Generation of Mathematical Knowledge; the section items seem to be addressed from the teacher control rather than the child centered approach. A re-examination of the section may be warranted.

The Math Anxiety Scale-Revised (MAS-R) was used on preschool caregivers and resulted in a mixed affect group. Additional interaction with the author of the tool may be needed to evaluate the reason for such results.

Intervention

Child care trainings that include content and processes for math should be offered to preschool caregivers. Child development college courses need to include mathematics courses that allow caregivers to develop and implement concepts and processes to enrich preschool math experiences. College developmental and core math courses need to recognize and implement anxiety recognizing and anxiety reducing activities as equally important as the math instruction to create successful college math students.

Summary

This chapter discussed a summary of the study as well as the findings related to the research questions. The chapter concluded with implications for preschool caregivers, child care centers, administrators, presenters, educators in child development, and policy makers, based on the findings and recommendations for future research.

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APPENDIX A

Permission to use Research Tools

July 8, 2010

Dear Dr. Cox,

Thank for your interest in using the MAS-R. I am happy to give you the permission to use the instrument, and I would appreciate if you could share your study results with me later. Here attached an electronic version of the final version of MAS-R. If you like, you may want to cite the later study as follows on this instrument which is clearer for the final items.

Bai, H. (2010). Cross-validating a bidimensional mathematics anxiety scale. *Assessment*. 1, 178-182.

Good luck with your study,
Haiyan

==========

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5 July 2010

Gail Cox, Department Chair
Temple College
1001 Alberta Lane
Harker Heights, TX 76548

Ms. Cox,

This letter provides permission to Gail Cox to use the following instruments for her dissertation work at Texas Women's University:

1) *Knowledge of Mathematical Development* (KMD) *Survey*
2) *Beliefs Survey*

Looking forward to working with you.

Linda M. Platas

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APPENDIX B

Sample of Research Tools

Demographic Questionnaire

Please select the best match for you in each question.

1. Are you currently employed at least 15 hours weekly as a preschool caregiver (children 3 through 5 years old) in a child care program in Bell or Coryell County or at Fort Hood?

   ☐ Yes ☐ No*

   *STOP: If you answer NO then you do not need to complete this packet of questionnaires.

2. Gender

   ☐ Female ☐ Male

3. What is your age?

   ☐ 18-24 ☐ 36-39 ☐ 50-59
   ☐ 25-29 ☐ 40-49 ☐ 60 and above
   ☐ 30-35

4. Racial/ethnic group

   ☐ African-American/Black
   ☐ Asian/Asian-American/Pacific Islander
   ☐ Caucasian/White
   ☐ Hispanic/Latino/Latina
   ☐ Native American/American Indian/Alaskan Native
   ☐ Multi-Ethnic (Please specify)
   ☐ _____

5. Are you currently enrolled in college as a Child Development/Education student?

   ☐ Yes ☐ No

6. What is the highest level of education you have completed?

   ☐ GED ☐ Associate's Degree
   ☐ High school ☐ Bachelor's Degree
   ☐ Child Development Certificate ☐ Master's Degree
   ☐ Some college course - number of courses: _____
   ☐ Other (Please specify)_____

7. What is the highest level of math you completed in high school? _____

8. What is the year of your high school completion? _____

9. Completed education levels in Child Development or Teacher Preparation. -- *Check all that apply.*

- ☐ Early Childhood Certificate
- ☐ CDA (Child Development Associate)
- ☐ Associate's Degree
- ☐ Bachelor's Degree
- ☐ Teacher Certification
- ☐ Master's Degree
- ☐ Other (Please specify)

_____

10. Have you taken any specific college math courses?

- ☐ NO
- ☐ Yes, developmental math
- ☐ Yes, College level math
- ☐ Yes, Math for Young Children

11. Have you participated in any professional development that included training about children's math activities within the last three years?

☐ Yes ☐ No ☐ Uncertain

12. How many years have you been a teacher/child care provider?

- ☐ The First year
- ☐ The Second year
- ☐ The third and fourth year
- ☐ 5-10 years
- ☐ 11-15 years
- ☐ 16-20
- ☐ 21-29
- ☐ 30 or more years

13. Your job title

- ☐ Lead Teacher
- ☐ Assistant teacher
- ☐ Substitute teacher
- ☐ Teacher / Director
- ☐ Other (specify)

_____

14. What ages of children do you work with most frequently?

- ☐ Threes
- ☐ Fours
- ☐ Fives
- ☐ Mixed threes and fours
- ☐ Mixed fours and fives
- ☐ Mixed threes, fours and fives

15. Program is licensed for:

- ☐ Less than 20 children
- ☐ 20 to 49 children
- ☐ 50 to 75 children
- ☐ 76 to 100 children
- ☐ 100 to 150 children
- ☐ 150 to 200 children
- ☐ More than 200 children

16. Type of program- *check all that apply*

- ☐ Privately Owned
- ☐ Church affiliated
- ☐ Franchise (ex. Peanut Gallery)
- ☐ Head Start
- ☐ 4-C Child Care
- ☐ Military Sponsored
- ☐ College Lab School
- ☐ Corporate owned (ex. Bright Horizons, Municipal)

17. Is your program accredited?

- ☐ Yes, by _____
- ☐ No

Please go on to the next section, Thank you.

Math Anxiety Scale – Revised (MAS-R)

Please circle the letter that best matches your feelings about Mathematics.

1. **I find math interesting.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

2. **I get uptight during math tests.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

3. **I think that I will use math in the future.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

4. **My mind goes blank and I am unable to think clearly when doing my math test.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

5. **Math relates to my life.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

6. **I worry about my ability to solve math problems.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

7. **I get a sinking feeling when I try to do math problems.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

8. **I find math challenging.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

9. **Mathematics makes me feel nervous.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

10. **I would like to take more math classes.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

11. **Mathematics makes me feel uneasy.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

12. **Math is one of my favorite subjects.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

13. **I enjoy learning with mathematics.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

14. **Mathematics makes me feel confused.**

A----------B----------C----------D----------E

Not true Slightly true Moderately true Mostly true Very true

Thank you for completing the Math Anxiety Questionnaire.
Please continue, there are two more sections to this study.

Bai, H. (2010). Cross-validating a bidimensional mathematics anxiety scale. *Assessment 1*, 176-182.

Knowledge of Mathematical Development Survey

For each of the following sets of statements, check the box corresponding to the statement that describes the math skill that a child is likely to learn first. If they are equally easy for a young child, check the box next to "Same." Do not guess if you do not know the answer, instead, check "Do not know".

---

1. ☐ Sam says the counting words in order from 1 to 10 (i.e., "1, 2, 3, 4, 5, 6, …).
   ☐ Sam says the counting words in order from 1 to 13 (i.e., "1, 2, 3, 4, 5, 6, …).
   ☐ Same
   ☐ Do not know

---

2. ☐ Jamie says the counting words in order from 1 to 10 (i.e., "1, 2, 3, 4, 5, 6, 7, 8, 9, 10").
   ☐ Jamie says the counting words in order from 6 to 10 (i.e., "Can you count starting with the number 6? Six…" Answer… "7, 8, 9, 10").
   ☐ Same
   ☐ Do not know

---

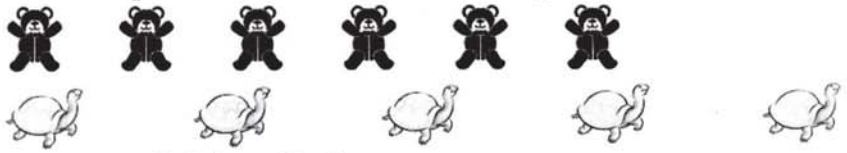
3. ☐ Pauli counts a group of seven buttons without touching them.
   ☐ Pauli counts a touchable group of seven buttons.
   ☐ Same
   ☐ Do not know

---

4. ☐ Angel matches seven forks in one-to-one correspondence with seven plates.
   ☐ Angel counts a row of seven forks.
   ☐ Same
   ☐ Do not know

---

5. ☐ Ali answers the question, "Are there more teddy bears or more turtles?"



☐ Ali counts a row of eight teddy bears.

☐ 

☐ Same

☐ Do not know

---

6. ☐ Shea answers the question "Here are two groups of teddy bears. How many all together?" when presented with two groups of two teddy bears.

☐ Shea answers the question: "What is two plus two?"

☐ Same

☐ Do not know

---

7. ☐ Jaiden answers, "How many buttons" after counting a set of six buttons.

☐ Jaiden counts a row of six buttons (i.e., "1, 2, 3, 4, 5, 6").

☐ Same

☐ Do not know

---

8. ☐ Micah answers the question, "What number comes after five?"

☐ Micah says the counting words in order from 1 to 6 (i.e., "1, 2, 3, 4, 5, 6").

☐ Same

☐ Do not know

---

9. ☐ Cimarron says the counting words in order from 1 to 10 (i.e., "1, 2, 3, 4, …).
   ☐ Cimarron counts a row of ten buttons. 
   ☐ Same
   ☐ Do not know

10. ☐ Cyprus answers the question, "What is five plus one?"
    ☐ Cyprus answers the question, "What is one plus five?"
    ☐ Same
    ☐ Do not know

11. ☐ Pilar counts a circle of seven buttons.
    ☐ Pilar counts a row of seven buttons.
    ☐ Same
    ☐ Do not know

12. ☐ Kaiden says the counting words in order from 1 to 6 (i.e., "1, 2, 3, 4, 5, 6").
    ☐ Kaiden answers the question, "What number comes before six?"
    ☐ Same
    ☐ Do not know

13. ☐ Amari is presented with two groups of buttons, one with five buttons and one with two buttons. When asked "How many altogether?" in the two groups, Amari counts all of the buttons beginning with the group of five buttons ("1, 2, 3, 4, 5, 6, 7").
    ☐ Amari is presented with two groups of buttons, one with five buttons and one with two buttons. When asked "How many altogether?" in the two groups, Amari counts on from the first set ("5, 6, 7"). 
    ☐ Same
    ☐ Do not know

14. ☐ Teagan answers the following addition question: "If you have these five cookies and I give you two more, how many cookies will you have altogether?" (all cookies are present).

☐ Teagan answers the following subtraction question: "If you have these three cookies and you give me one, how many cookies will you have left?" (all cookies are present)

☐ Same

☐ Do not know

---

15. ☐ Kim divides twelve cookies between two puppets equally ("Here are twelve cookies, can you give Elmo and Ernie the same number of cookies?").

☐ Kim divides twelve cookies between three puppets equally ("Here are twelve cookies, can you give Elmo, Ernie, and Bert the same number of cookies?").

☐ Same

☐ Do not know

---

16. ☐ Sage counts a row of seven buttons.

☐ Sage produces a group of seven buttons from a larger set (i.e., "Can you take seven buttons out of this box of buttons?).

☐ Same

☐ Do not know

---

17. ☐ Justine writes one digit numerals (i.e., can write the number symbol "4").

☐ Justine recognizes one digit numerals (i.e., can point out a "4" in a small group of printed numbers).

☐ Same

☐ Do not know

---

18. ☐ In a line of five toy sheep facing the same direction, Indigo answers the question, "Point to the second sheep in line." 

☐ In a line of five toy sheep facing the same direction, Indigo answers the question, "Point to the first sheep in line."

☐ Same

☐ Do not know

---

19. ☐ Peyton counts a group of 8 buttons (not in a row).

☐ Peyton counts a row of 8 buttons.

☐ Same

☐ Do not know

---

20. ☐ Daevon recognizes one digit numerals (for instance, can point out a "4" in a group of printed numbers).

☐ Daevon reads single digit number words (for instance, can read the word "four").

☐ Same

☐ Do not know

Beliefs Survey

Check the box that best describes your agreement/disagreement with the statement (check only one box).

Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree	
☐	☐	☐	☐	☐	☐	1. Math is an important part of the preschool curriculum.
☐	☐	☐	☐	☐	☐	2. It is better to wait until kindergarten for math activities.
☐	☐	☐	☐	☐	☐	3. Mathematical activities are an inappropriate use of time for preschoolers; because they aren't ready for them.
☐	☐	☐	☐	☐	☐	4. Preschoolers are capable of learning math.
☐	☐	☐	☐	☐	☐	5. I am knowledgeable enough to teach math in preschool.
☐	☐	☐	☐	☐	☐	6. Math flashcards are appropriate for preschoolers.
☐	☐	☐	☐	☐	☐	7. Math activities are good opportunities to develop social skills in preschool.
☐	☐	☐	☐	☐	☐	8. Preschoolers learn mathematics *without* support from teachers.
☐	☐	☐	☐	☐	☐	9. Math activities are a very important part of the preschool experience.
☐	☐	☐	☐	☐	☐	10. The teacher should play a central role in preschool mathematics activities.
☐	☐	☐	☐	☐	☐	11. Teaching mathematics to preschoolers is/would be uncomfortable for me.
☐	☐	☐	☐	☐	☐	12. Supporting development in academic subjects such as math is the *primary* goal of preschool education.

Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree	
☐	☐	☐	☐	☐	☐	13. Preschoolers learn mathematics *best* through direct teaching of basic skills.
☐	☐	☐	☐	☐	☐	14. I am unsure how to support math development for young children.
☐	☐	☐	☐	☐	☐	15. Most preschoolers are ready for participation in math activities.
☐	☐	☐	☐	☐	☐	16. Social and emotional development is the *primary* goal of preschool and time spent on math takes away from this goal.
☐	☐	☐	☐	☐	☐	17. Math is/would be a difficult subject for me to teach in preschool.
☐	☐	☐	☐	☐	☐	18. Teachers can help preschoolers learn mathematics.
☐	☐	☐	☐	☐	☐	19. In preschool, children should learn *specific* procedures for solving math problems (i.e., 2 + 4).
☐	☐	☐	☐	☐	☐	20. Preschool math will weaken preschoolers' self confidence.
☐	☐	☐	☐	☐	☐	21. I can think of many math activities that would be appropriate for preschoolers.
☐	☐	☐	☐	☐	☐	22. Children are ready for math activities in preschool.
☐	☐	☐	☐	☐	☐	23. In preschool, children construct their mathematical knowledge *without* the help of a teacher.
☐	☐	☐	☐	☐	☐	24. I don't know enough math to teach it in preschool.
☐	☐	☐	☐	☐	☐	25. Teachers should help preschool children memorize number facts (for instance, 2+3).

Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree	
☐	☐	☐	☐	☐	☐	26. Preschool children are *not* socially or emotionally ready for math activities.
☐	☐	☐	☐	☐	☐	27. Math would be easy for me to incorporate into preschool curricula.
☐	☐	☐	☐	☐	☐	28. If a preschool teacher spends time in math activities in the classroom, social and emotional development will be neglected.
☐	☐	☐	☐	☐	☐	29. Math is confusing to preschoolers.
☐	☐	☐	☐	☐	☐	30. I can create effective math activities for preschoolers.
☐	☐	☐	☐	☐	☐	31. Academic subjects such as mathematics are too advanced for preschoolers.
☐	☐	☐	☐	☐	☐	32. Preschool teachers are responsible for making sure that preschoolers can learn the right answer in mathematics.
☐	☐	☐	☐	☐	☐	33. Math worksheets are appropriate for preschoolers.
☐	☐	☐	☐	☐	☐	34. I don't know how to teach math to preschoolers.
☐	☐	☐	☐	☐	☐	35. Mathematical activities are age-appropriate for preschoolers.
☐	☐	☐	☐	☐	☐	36. Teachers should show preschoolers the correct way of doing mathematics.
☐	☐	☐	☐	☐	☐	37. Very *few* preschoolers are ready for math in preschool.
☐	☐	☐	☐	☐	☐	38. Before kindergarten, preschool teachers should make sure preschoolers memorize verbal counting numbers.

Strongly Agree	Agree	Somewhat Agree	Somewhat Disagree	Disagree	Strongly Disagree	
☐	☐	☐	☐	☐	☐	39. Math is a worthwhile and necessary subject for preschoolers.
☐	☐	☐	☐	☐	☐	40. I know how to support math learning in preschool.

APPENDIX C

Consent Form

TEXAS WOMAN'S UNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

Title: Preschool caregivers' mathematical anxiety: Examining the relationship between mathematical anxiety and knowledge and beliefs about mathematics for young children.

Investigator: Gail J. Cox, M. S. ..... gecox12@earthlink.net 254/768-6775
Advisor: Lin Moore, PhD .....LMoore@twu.edu 940/898-2210

Explanation and Purpose of the Research

You are being asked to participate in a research study for Ms. Cox's dissertation at Texas Woman's University. The purpose of this research is to better understand the relationship between preschool caregivers comfort level with mathematics and their understanding of mathematics for preschool children.

Description of Procedures

As a participant in this study you will be asked to complete a four part paper and pencil survey. This survey will take between 15-20 minutes of your time. In order to be a participant in this study, you must be a preschool child caregiver working at least 15 yours weekly in a licensed child care center in Bell or Coryell counties in Texas.

Potential Risks

The researcher surveys will ask you questions about mathematical anxiety, and your knowledge and beliefs about mathematics for young children.

Confidentiality will be protected to the extent allowed by law.

A possible risk in this study is that preschool caregivers who are college students may feel coerced to participate in the study because the survey packets will be distributed by instructors. To minimize this risk the consent form which identifies the participant is separated from the survey packet by the participant and turned in separately in a sealed white envelope. The researcher and college instructors will not have a way to identify the responses of any individual participant. Consent forms will be securely stored by the Temple College Business and Career Professions secretary. Temple College students' survey packets will be turned in to Business and Career Professions secretary. Data will be aggregated for reporting.

A possible risk in this study is that preschool caregivers may feel coerced to participate in the study because the survey packets will be distributed by the child care center director. To minimize this risk the consent form which identifies the participant is separated from the survey packet by the participant and turned in separately in a sealed white envelope. The directors and researcher will not have a way to identify the responses of any individual participant. Data will be aggregated for reporting.

Initials

An additional possible risk in this study is that participants may feel anxiety if they are unsure of answers to the questions about knowledge of children's mathematical development. To minimize this risk participants may stop at any time and then return to the survey or choose not to complete the forms. Participants will be provided with the email address and phone number of the researcher so that they can ask questions at any time. The researcher will visit child care centers upon request of a participant to answer any questions.

An additional possible risk in this study is that participants may feel there is a potential for loss of confidentiality to individuals that participate. To minimize this risk participants consent forms and the survey packets will not be stored in the same area after pickup by the researcher. The directions to the participants include the method of collecting consent forms and packets separately. Center directors and instructors who distribute the packets will not be asked who participated.

An additional possible risk in this study is that participants may feel fatigue when answering the four sections of the study. To minimize this risk the instructions indicate that participants can stop and continue the study at a later time. It states that the study does not have to be completed at one time. The instructions also say that the participant is free to discontinue participation at any time and turn in the packet.

There is a potential risk of loss of confidentiality in all email, downloading and internet transactions.

The researchers will try to prevent any problem that could happen because of this research. You should let the researchers know at once if there is a problem and they will help you. However, TWU does not provide medical services or financial assistance for injuries that might happen because you are taking part in this research.

Participation and Benefits

Your involvement in this study is completely voluntary and you may withdraw from the study at any time. Following the completion of the study you will receive a set of six to eight math activities and resources. This booklet will be delivered to all preschool caregivers in the centers as a thank you. Copies of the math activities will be available to all child development students at both community colleges. The summary of the study will be available to students at both community colleges and each center who allowed data collection.

Questions Regarding the Study

You will be given a copy of this consent form to keep. If you have any questions about the research study you should ask the researchers; their phone numbers are at the top of this form. If you have questions about your rights as a participant in this research or the way this study has been conducted, you may contact the Texas Woman's University Office of Research and Sponsored Programs at 940-898-3378 or via e-mail at IRB@twu.edu.

Signature of Participant _____ Date _____

APPENDIX D

Instructions for Completing Survey Packet

Dear Directors of Preschool Child Care Programs in Bell and Coryell County

Thank you for agreeing to allow your preschool caregivers to participate in my doctorial dissertation study. The title of the study is:

PRESCHOOL CAREGIVERS' MATHEMATICAL ANXIETY: EXAMINING THE RELATIONSHIPS
BETWEEN MATHEMATICAL ANXIETY, AND KNOWLEDGE AND BELIEFS ABOUT MATHEMATICS FOR YOUNG CHILDREN

Here is an overview of the process for data collection as it affects your center:

1. Provide letter of agreement to participate on your center letterhead to researcher.
2. I understand that there is a potential risk of loss of confidentiality in all email, downloading and internet transactions.
3. Identify number of preschool caregivers in your program, and contact researcher to bring by the number of needed survey packets.
    a. (Gail Cox 254-298-8624 /·cell 254-768-6775 gecox12@earthlink.net)
4. Encourage preschool caregivers to either use free time at work or home to complete the surveys. The total time need to complete the survey is 15-20 minutes.
5. Consent forms will be included in the survey packet. Participants are requested to return them in a sealed whit 4 ½ x 9 white envelop. Please store them in the "Consent form" marked envelop. You will not be asked to provide any information about the consent form or the study. If a participant has any questions direct them to call, email or request a visit from the researcher. Appointments for visits will be made to individuals as requested. The researcher's information appears in item 2.
6. Surveys in the packet:
    a. Demographics, Mathematics Anxiety Scale (MAS-R), Knowledge of Mathematical Development Survey and Beliefs Survey.
7. Researcher team member will pick up all survey packets and consent forms within the week.
8. The research begins in November and ends in December, 2010.
9. Math Activities Booklets will be provided in June, 2011. Centers with participating caregivers will receive paper copies of 6 to 8 ideas and additional resources for math activities for preschool classrooms for each preschool caregiver.
10. At the end of the research each center that allowed data collection will receive a summary copy of the report.
11. Opportunities to attend community trainings related to "Mathematics for Young Children" will be scheduled in 2011 and 2012.

Instructions for participating in Gail Cox's dissertation survey

Thank you for taking time out of your busy day to complete this four part survey about **Mathematics and Young Children**. The survey is divided into four parts, and will take approximately 20 minutes to complete. The entire survey does not have to be completed in one sitting. You are encouraged to finish the whole set but may choose to stop at any time. All participation is voluntary.

Steps to participation:

1. Read the consent form and if you are comfortable continuing, sign the consent form and place it in the 4 1/2 x 9 white envelopes attached to the form.
    a. A copy of the consent form is on the reverse side of this instruction sheet for your records.
2. Read and complete the four section survey packet.
3. Return the completed survey packet to the clasp envelope.
4. Give the survey packet in the clasp envelope back to the center director or instructor.
5. Give the CONSENT FORM ENVELOPE to the center director or instructor. This envelop will be placed in a separate envelope designated for consent forms.
6. Accept my deepest appreciation for participating in the study.
    a. To express my thanks, in June 2011 look for a small booklet of math activities to use in the classroom with preschool children will be provided to you and your center.
    b. A summary of the study results will be given to each center upon completion of the study. If individuals would like a copy of the summary or the complete dissertation, they can contact me by email me at gecox12@earthlink.net or phone 254-768-6775. The study results will be shared in professional development at the local workshops in 2011-2012.

APPENDIX E

Sample Letter of Agreement

Letter of Agreement

Date

Company name will allow data collection in the form of four surveys as part of Gail Cox's dissertation research at Texas Woman's University.

PRESCHOOL CAREGIVERS' MATHEMATICAL ANXIETY: EXAMINING THE RELATIONSHIPS
BETWEEN MATHEMATICAL ANXIETY, AND KNOWLEDGE AND BELIEFS
ABOUT MATHEMATICS FOR YOUNG CHILDREN

I understand that by agreeing to allow staff to participating in the study I will be asked to receive, distribute and collect survey packets and consent forms, the packets will be collected by researcher or assistant. I understand that preschool caregivers in my program will be asked to complete the packet of four short surveys about mathematics for young children. The surveys are designed so that preschool caregivers can complete them in about 20 minutes. The researcher or her representative will drop the survey packets off and then come back and pick them up within the week. Any preschool caregiver can choose to complete the survey or stop at any time.
I understand that there is a potential risk of loss of confidentiality in all email, downloading and internet transactions.

_____ _____

Name, Center Director Date

Please indicate the number of preschool caregivers you have in your program

_____