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**A Survey Study of Early Childhood
Teachers' Beliefs and Confidence about
Teaching Early Math**

by Jie-Qi Chen and Jennifer McCray

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Abstract

Although increased attention to early mathematics education is widespread, knowledge of what preschool teachers think about early math teaching and how confident they are in helping preschoolers learn math remains limited. To begin filling this information gap, we report on the results of the Early Mathematics Belief and Confidence Survey, a study involving 346 preschool teachers in a large public school system in the Midwest. The survey was designed to address three questions : (1) What do preschool teachers believe about teaching and learning math with preschoolers? (2) How confident are preschool teachers in helping preschoolers learn math? (3) How confident are preschool teachers about their own math abilities? The survey results depict a complex, yet promising, picture of early childhood teachers' beliefs and confidence in early math teaching. We found a much more positive view of teachers' beliefs and confidence in early math teaching than previously described in the literature. We also observed that level of teacher confidence varies with specific types of math knowledge and teaching abilities. We further detected the difference as well as the relationship between teachers' confidence in their own math abilities and their confidence in teaching math to young children. The results have important implications for the design of professional development in early math.

A Survey Study of Early Childhood Teachers' Beliefs and Confidence about Teaching Early Math

The importance of early mathematics education has drawn increasing attention in recent years (Duncan, et al., 2007; NRC, 2009). While research evidence is clear that young children have the capacity to learn math and benefit from doing so (see NRC for a summary report, 2009), it is largely unknown whether this is a belief commonly held by preschool teachers. Similarly, while early childhood teachers are generally described as lacking confidence in teaching math (Copley, 2004), surprisingly few studies have examined teacher confidence in relation to teaching tasks such as planning learning activities or assessing children's math understanding. Lastly, while we know that young children's performance in mathematics depends on their teachers' mathematical proficiency (Sarama & DiBiase, 2004), we know little about which specific math teaching tasks teachers feel proficient in. Our limited understanding of teachers' perspectives on early math teaching diminishes our ability to support teachers in the classroom and makes it difficult to meet their math professional development (PD) needs.

Responding to these gaps in the research literature, in this article we report on a survey of preschool teachers' beliefs and confidence designed to address three questions: (1) What do preschool teachers believe about teaching and learning math with preschoolers? (2) How confident are preschool teachers in helping preschoolers learn math? (3) How confident are preschool teachers about their own math abilities? Results and their implications for the design of early math professional development are discussed.

Method

Participants

A total of 346 preschool teachers in a large, urban, public school system in the Midwest completed the survey. Of these, 88% (n=304) taught two half-day preschool classes and the remaining 12% (n=42) worked in full-day programs. The number of years teachers had worked with preschool children ranged from 1 to 34, with a mean of approximately 9 years. In the sample, 228 teachers (66%) worked with students from low-income family backgrounds and 109 teachers (32%) spoke Spanish regularly in their classrooms. Because they worked in a public school system, all teachers had teaching certificates. On average, teachers had completed 3.8 pre-service math and math methods classes ($SD = 6.7$), and they had participated in 4.9 hours of in-service math PD over the last three years ($SD = 7.1$)

Measure

Designed specifically for use in this study, the Early Math Beliefs and Confidence Survey (EM-BCS) consists of 28 questions that assess three aspects of teacher belief and confidence (see Appendix A): (a) teachers' beliefs about preschoolers and math; (b) teachers' confidence in helping preschoolers learn math; and (c) teachers' confidence in their own math abilities. The survey presents a series of first person statements, such as "Most children in my class are very interested in math." Teachers used a five point Likert scale to indicate their degree of agreement or disagreement with each statement. The five points on the rating scale were labeled strongly agree, agree, neutral, disagree, or strongly disagree.

The validity of the EM-BCS was established through an extensive literature review and consultation with experts in early math education. Reference to the curriculum focal points of NCTM for pre-kindergarten (2010) guided selection of the mathematical content for the survey. Internal consistency of the scale domains was assessed using Chronbach's alpha with the current sample. The alpha is .80 for teachers' beliefs about preschoolers and math, .90 for teachers' confidence in helping preschoolers learn math, and .84 for teachers' confidence in their own math abilities. To evaluate test-retest reliability, the survey was administered to the same group of teachers twice, with 18 months in between. No significant differences were found in any of the three areas between the two sets of results, indicating a high degree of reliability of survey items over time. The Time 1 data set was used in this study.

Procedure

The EM-BCS was administered to all pre-kindergarten teachers in May, at the conclusion of a system-wide meeting. A total of 354 teachers attended the meeting. Teachers were informed that the survey would be used to help administrators better meet teachers' professional development needs in early math. The survey took teachers approximately 15 minutes to complete. Teachers completed the survey anonymously. Of the 354 surveys distributed, 346 were completed and returned, yielding a response rate of 98%. With all pre-kindergarten teachers expected to attend the meeting and time allotted to complete the survey during the meeting, the response rate was unusually high.

Results

Teachers responded to survey statements by rating their degree of agreement or disagreement with the statement, using a five point Likert scale. Results describe the total percentage of teachers who either agreed or strongly agreed with each survey statement.

Beliefs About Preschoolers and Math

A large majority of teachers expressed the belief that early math education is appropriate for young children. Specifically, 89.9% of teachers believed that young children have the cognitive abilities to learn math. Further, three-fourths (76.5 %) believed that preschoolers are interested in learning math. Rating their beliefs about the importance of early math instruction, 96.8% of teachers agreed that preschoolers need to learn math to be ready for kindergarten. Consistent with this belief, 90.3% indicated that preschoolers should be helped to learn math in preschool. Underscoring the need for early math education, 62.1% of teachers held that most children in their class entered preschool with very little math knowledge. Asked how preschoolers learn math, a large majority (87.6 %) of teachers responded that young children learn a lot about math through everyday experiences. Less than a third of the teachers (30.5%) thought preschoolers need structured math instruction and about a fifth (19.2%) favored the use of a published early math curriculum.

Confidence in Helping Preschoolers Learn Math

The survey section on helping preschoolers learn math included statements about teachers' confidence in their knowledge of teaching early math and confidence in their ability to teach early math (see Figure 1). Rating confidence in their knowledge of the specifics of teaching early math, a majority (85.8 %) of teachers were confident that they knew reasonable math goals for preschoolers. Well over half felt confident that they knew the best practices and strategies for helping preschoolers learn math (68.6 %) and the professional standards for early math learning (68.0 %). Fewer, but still more than half, of teachers agreed they knew the best ways to assess children's math knowledge and understanding (57.4%) and knew what children in their classroom know about math when they enter preschool (54.8%).

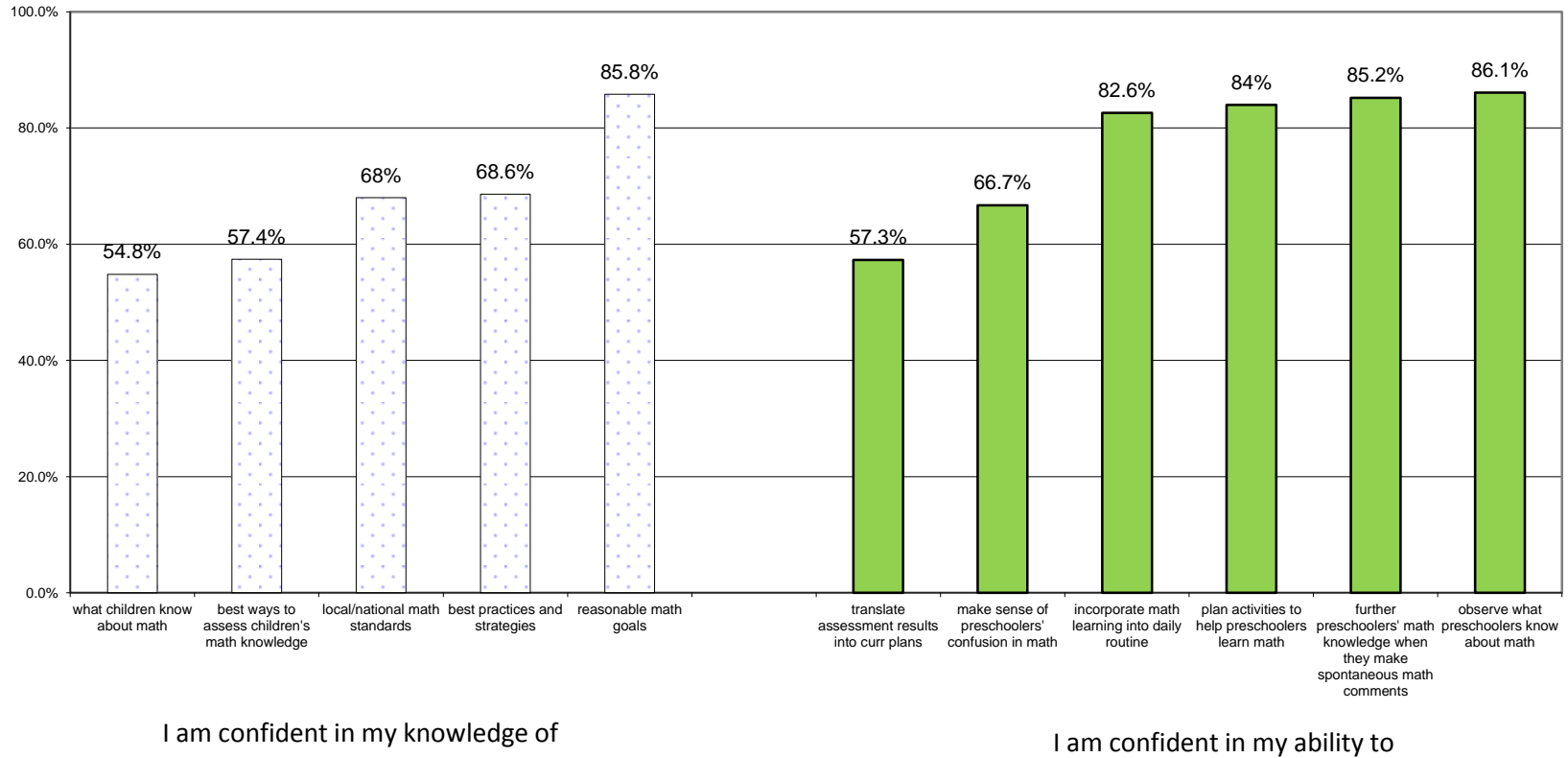
Teachers reported greater overall confidence in their ability to teach preschoolers math than they did in their knowledge of teaching it. Specifically, more than 80% of teachers agreed that they were confident in planning activities to help preschoolers learn math, incorporating math learning into familiar preschool activities such as dramatic play, and observing what preschoolers know about math. More than half of teachers expressed confidence in their ability to makes sense of preschoolers' confusions about math (66.7%) and translate assessment results into curriculum plans (57.3%).

Teachers' Confidence in Their Personal Math Abilities

In this survey section, teachers were asked to rate their confidence in their general and specific math abilities (see Figure 2). Responding to statements about

Figure 1

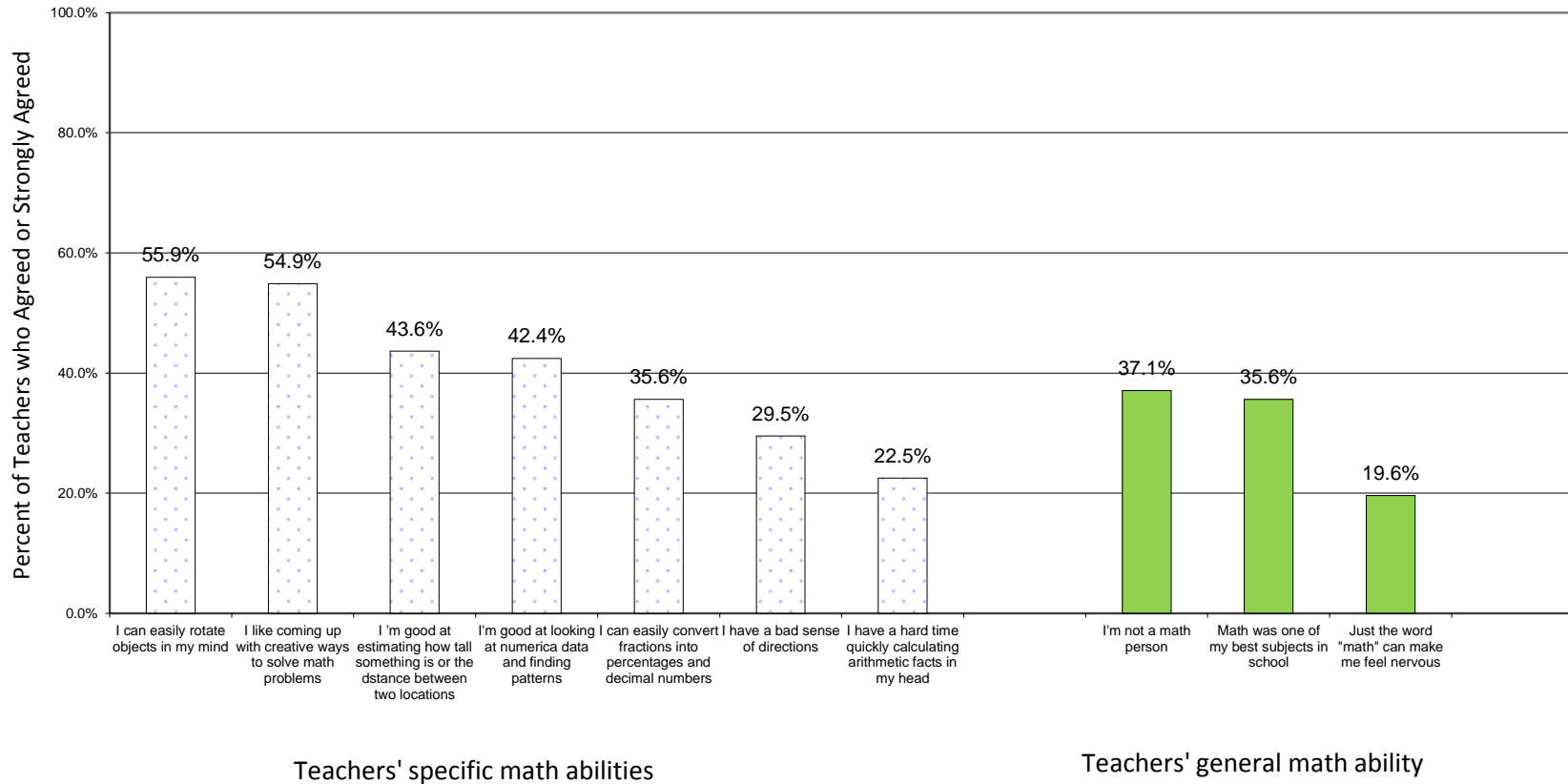
Percent of Teachers Who Agreed or Strongly Agreed with Statements about Teachers' Confidence in Helping Preschoolers Learn Math



Note. Number of teachers who responded to each of the questions ranged from 333 to 339.

Figure 2

Percent of Teachers Who Agreed or Strongly Agreed with Statements about Teachers' Confidence in Their Own Math Abilities



Note. Number of teachers who responded to each of the questions ranged from 333 to 338.

their general ability, slightly more than a third of teachers (35.6%) agreed that math was one of their best subjects in school. Approximately the same percentage (37.1%) indicated they did not see themselves as “a math person.” Less than a fifth of the teachers (19.6 %) indicated that just the word “math” can make them nervous.

In terms of specific math abilities, about half of teachers (54.9%) reported being confident in coming up with creative ways to solve math problems. Less than half of the teachers agreed they were good at estimating height or distance (43.6%) or at finding patterns in numeric data (42.4%). Teachers were least confident in their ability to calculate arithmetic facts in their head. Only 22.5 % expressed confidence in this skill.

Finally, teachers’ confidence in helping preschoolers learn math was compared with their confidence in their own math abilities. The result indicates that the teachers’ confidence in their own math abilities ($M=2.89$, $SD=1.23$) was significantly lower than their confidence in helping preschoolers learn math ($M=3.80$, $SD=1.02$) ($t(302) = -25.06$, $p < .001$).

Discussion

In the discussion, we focus on four key findings: (1) positive teacher beliefs and confidence in early math teaching, (2) teacher confidence in relation to specific teaching activities, (3) teachers’ lack of confidence in assessing math learning, and (4) teachers’ confidence in “personal” and “professional” math. Discussing the results, we also consider their implications for early math PD.

Positive Teacher Beliefs and Confidence in Early Math Teaching

Previous literature has largely focused on early childhood teachers’ concerns about the developmental appropriateness of math (Copley, 2004; Ginsburg, Lee, & Boyd, 2008). Further, preschool teachers are generally portrayed as disliking math, lacking confidence and the requisite knowledge to teach early math, being anxious about teaching it, and trying to avoid teaching it (Ginsburg, Lee, & Boyd, 2008; NAEYC & NCTM, 2010). Results of this survey describe a strikingly different picture. First, these preschool teachers believe that early math is developmentally appropriate for young children and that early math instruction is necessary to prepare them for kindergarten. They also believe preschoolers have the ability to learn math and want to learn it. Teachers report confidence in their specific abilities to set goals and plan math activities, incorporate math learning into a variety of situations, and observe what preschoolers know about math.

In PD, teachers can also be helped to expand teaching opportunities by drawing on their beliefs. Teachers express a strong belief that children learn a great deal of math through everyday experiences. To build on this belief, PD can be structured to increase teachers' awareness of what these experiences are and when they occur. This type of learning experience in PD will help teachers think, in specific terms, about how to use everyday experiences to “mathematize” children’s learning and thinking (NRC, 2009).

Variability in Teachers’ Confidence in Math Teaching and Their Personal Math Ability

Survey results showed that a large majority of teachers felt confident in their knowledge of what math to teach and their ability to teach it to young children. Teachers were less confident in what children know about math at school entry, the best ways to assess children’s math knowledge, and their ability to translate assessment results into curriculum plans. This pattern of results indicates that teacher confidence varies with specific types of math knowledge and types of teaching ability. Teachers’ confidence in their personal math abilities also varied. Asked if they were confident about doing specific math tasks, such as “looking at numerical data and finding patterns,” teacher agreement ranged from 22.5% to 55.9%. Feeling confident about a specific skill did not mean teachers saw themselves as good at math skills in general.

In both types of teacher confidence—confidence in teaching math and in their personal math abilities—variability suggests teachers have areas of relative strength and weakness, a finding with particular relevance to the design of effective PD. Developing PD content based on generalizations about early childhood math teachers is likely to miss the target of what is appropriate in relation to a specific group of teachers. As with teaching math to young children, PD will have limited effects if it is not aligned with teachers’ specific needs. Consulting with teachers when planning PD will help to ensure that experiences are responsive to the full range of teacher variability.

Teachers’ Lack of Confidence in Assessing Math Learning

An area that requires great attention in PD is the assessment of early math knowledge and skills in young children. Results indicate that despite their overall confidence in helping preschoolers learn math, teachers were less confident about how to assess children’s math knowledge and skills. Specifically, a large number of teachers indicated they did not feel confident in their knowledge of what children know about math when they start school. Unclear about the status of children’s math knowledge and skills, teachers are also unsure about the best ways to gather such information. Even when the information is available, they lack confidence in their ability to translate the assessment results into curriculum plans.

In PD, positive beliefs and confidences can serve as bridges to strengthen areas where teachers experience difficulty. For example, PD can be designed to link teachers' confidence in goal-setting, planning, and observation to the practice of assessing children's math learning, an area where teachers are less confident. Making this connection requires teachers to see that assessment reveals children's progress in relation to the goals they have set. As teachers assess what children are learning, they can adjust their program goals to fit children's needs. Engaging in assessment becomes meaningful and useful to teachers because it is based on their goals for children. As teachers apply their developing skills in the assessment of children's learning, they can continue to build their confidence.

Teachers' Confidence in "Personal" and "Professional" Math Abilities

The survey results showed that teachers' confidence in their ability to teach preschoolers math is greater than their confidence in their own math ability. This discrepancy between "professional" and "personal" mathematics suggests that preschool teachers may not feel they are good at math, but believe they can teach early math fairly well. Of concern regarding this finding is the possibility that teachers think early math is simple, easy, and requires little mathematical knowledge to teach. It is also possible that greater confidence in helping children learn math comes from a long recognized strength of early childhood teachers; namely, knowing children well and feeling comfortable interacting with them.

This finding presents both a challenge and an opportunity to design specific early math PD. The challenge resides in the misconception that teaching early mathematics is easy since it is about the most basic math. Early math is basic but not simple; rather it is abstract, complex, and foundational (McCray & Chen, 2011; NRC, 2009). Of critical importance to PD effectiveness is to strengthen teachers' understanding of foundational math, including big ideas—the key mathematical concepts that lay the foundation for life-long mathematical learning and thinking in diverse content areas—and help them to form strong connections among these ideas. Such training helps teachers develop adaptive expertise for teaching foundational mathematics so that they can take advantage of "teachable moments" and ground their teaching in those ideas most central to the development of mathematical thinking (Sarama & DiBiase, 2004).

Limitations

Survey studies are based on self-report data. They are subjective and reflect each individual's understanding of the survey questions and willingness to be truthful. It is possible that in-service teachers, surveyed in the workplace, might feel pressure to report more "socially acceptable" beliefs, greater confidence, and more positive math attitudes than they actually possess. In an attempt to reduce

this pressure, teachers were informed of the purpose of the survey; namely, to help administrators plan early math PD that better meets their needs. Understanding that survey results were to be used in planning their math PD may have elicited more candid responses, potentially moderating the limitations of self-report data.

Conclusion

Previous research indicates that beliefs and confidence are closely related to teachers' knowledge acquisition and classroom practice (Pajares, 1996; Vartuli, 2005). Beliefs and confidence affect teachers' thinking, motivation, and behavior as well as mediate their skill development and teaching (Pajares, 1996). Whether or not teachers are helped to examine beliefs and develop confidence about early math, their beliefs and confidence directly influence their math teaching. Results of the present study show the many forms that influence can take. Professional development experiences are always filtered through beliefs and affected by teachers' confidence. For this reason, PD that integrates beliefs and confidence is likely to produce stronger learning outcomes that teachers sustain for longer periods of time (Handal & Herington, 2003; Wilkins, 2008).

Although portrayals of early math teaching in the literature are generally critical, the results of this survey study find early childhood teachers possess many strengths that support math teaching. Building on these strengths will likely increase teachers' willingness to learn even outside of their comfort zone. Building on strengths also adds to teachers' experience of success, which, in turn, increases teacher confidence. Success and confidence can fuel teachers' participation in PD and reinforce their belief that they are capable of becoming proficient in teaching early math. In a joint statement, NAEYC and NCTM (2002) advise pre-service education programs and in-service PD to do more to encourage the development of teachers' confidence and positive dispositions toward math. Survey results and their implications for PD are consistent with this recommendation.

References

- Copley, J.V. (2004). The early childhood mathematics collaborative: A professional development model to communicate and implement the standards. In D. H. Clements & J. Sarama (Eds.), *Engaging young children in mathematics: Standards for early mathematics education* (pp.401-414). Mahwah, NJ: Lawrence Erlbaum.
- Duncan F. J., Dowsett, C. J., Claessent, A., Magnuson, K., Huston, A. C., Klebanove, P., Pagani, L. S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K., & Japel, C. (2007). School readiness and later achievement. *Developmental Psychology, 43*(6), 1428-1446.
- Ginsburg, H. P., Lee, J. S., & Boyd, J. S. (2008). *Mathematics education for young children: What it is and how to promote it*. Society for Research in Child Development, Social Policy Report, Vol. 22(1).
- Handal, B. & Herrington, A. (2003). Mathematics teachers' beliefs and curriculum reform. *Mathematics Education Research Journal, 15*(1), 59-69.
- McCray, J. & Chen, J. Q. (2011). Foundational mathematics: A neglected opportunity. In B. Atweh, M. Graven, W. Secada, & P. Valero (Eds.), *Mapping equity and quality in mathematics education* (pp. 253-268). New York, NY: Springer.
- NAEYC & NCTM (2002). *Early childhood mathematics: Promoting good beginnings*. Washington, DC: Authors.
- NAEYC & NCTM. (2010). *Focus in pre-kindergarten: Teaching with curriculum focal points*. Reston, VA: Authors.
- National Research Council. (2009). *Mathematics learning in early childhood: Paths toward excellence and equity*. Washington, DC: National Academy Press.
- Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research, 66*(4), 543-578.
- Sarama, J., & DiBiase, A.-M. (2004). The professional development challenge in preschool mathematics. In D. H. Clements, J. Sarama, & A.-M. DiBiase (Eds.), *Engaging young children in mathematics: Standards for early childhood education* (pp. 415-446). Mahwah, NJ: Lawrence Earlbaum.
- Vartuli, S. (2005). Beliefs: The heart of teaching. *Young Children, 60*(5), 76-86.

Wilkins, J. L. (2008). The relationship among elementary teachers' content knowledge, attitudes, beliefs, and practices. *Journal of Mathematics Teacher Education*, 11(2), 139-164.

Appendix A

Factor Loading of the Early Math Beliefs and Confidence Survey

Teacher Beliefs about Preschoolers and Math			
Most children in my class _____.	Factor 1	Factor 2	Factor 3
1. <u>enter preschool</u> with little math knowledge	0.45234	0.11761	-0.05676
2. have the <u>cognitive abilities</u> to learn math	0.58756	-0.09127	-0.01615
3. <u>should be helped to learn math</u> in preschool	0.11617	0.31859	-0.02073
4. are <u>very interested</u> in learning math	0.42294	-0.20873	-0.04726
5. need to learn math in preschool to be <u>ready for kindergarten</u>	0.25777	-0.09506	-0.04234
6. learn a great deal about math through their <u>everyday activities</u>	0.36239	-0.24477	-0.03417
7. need <u>structured preschool math instruction</u>	0.45896	0.09484	-0.00387
8. should be helped to learn math using a <u>published math curriculum</u>	0.46987	0.02886	0.09970
Teacher Confidence in Helping Preschoolers Learn Math			
I am confident in my knowledge of _____.	Factor 1	Factor 2	Factor 3
1. what the children in my classroom <u>know about math when they enter preschool</u>	-0.05265	0.38878	0.09592
2. reasonable math <u>goals</u> for preschoolers	-0.18134	0.60404	0.14855
3. the <u>best practices and strategies</u> for helping preschoolers learn math	-0.19586	0.65268	0.18223
4. local or national math <u>standards</u> for preschoolers	-0.23240	0.54607	0.12434
5. the best ways to <u>assess</u> children's math knowledge and understanding throughout the year	-0.12097	0.70205	0.18941
I am confident in my ability to _____.			
6. <u>observe</u> what preschoolers know about math	-0.03746	0.69480	0.13891
7. <u>incorporate</u> math learning into common preschool situations (such as art or dramatic play)	0.01660	0.72321	0.07503
8. <u>plan</u> activities to help preschoolers learn math	0.07190	0.75682	0.17571

9. <u>further preschoolers' math knowledge</u> when they make spontaneous math comments/ discoveries	0.03209	0.66782	0.08745
10. <u>make sense of preschoolers' confusions</u> when they learn math	-0.03086	0.65534	0.13029
11. <u>translate</u> assessment results into curriculum plans	-0.10653	0.66645	0.20925
Teachers' Confidence in Their Personal Math Abilities			
	Factor 1	Factor 2	Factor 3
1. Math was one of my best subjects in school.	0.05326	0.07744	0.74035
2. Just the word "math" can make me feel nervous.	-0.09265	-0.00995	0.69580
3. I'm not a "math person."	-0.06231	-0.02884	0.79593
4. I can easily rotate objects in my mind	-0.00164	0.30085	0.45136
5. I like coming up with creative ways to solve math problems.	0.01452	0.30756	0.54010
6. I can easily convert fractions into percentages and decimal numbers.	-0.04116	0.17147	0.59320
7. I have a bad sense of direction.	-0.05867	0.06295	0.37749
8. I'm good at looking at numeric data and finding patterns.	-0.03649	0.17725	0.57053
9. I'm good at estimating how tall something is or the distance between two locations.	0.06714	0.15325	0.42302