

## RESEARCH-TO-PRACTICE SUMMARY

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### In Early Childhood Mathematics Education (ECME), Teachers' Beliefs Count

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Research suggests that teaching practice is directly influenced by the beliefs teachers hold Brown, 2005; Cross et al, 2009; Pajares, 1992; Vartuli, 1999. To address this, early childhood teacher beliefs about mathematics and Early Childhood Mathematics Education (ECME) were studied via a survey. The findings show that teachers may not hold as negative a view about ECME as has been previously reported and further, that they seem to be engaging in more ECME in the classroom. However, the results also suggest that today's ECME practice may be counter to current research-based guidelines, in terms of both scope and methods of instruction. Recommendations are made for what preschool teachers can do to optimize ECME in their classroom.

#### ECME IN THE PAST

For the early half of the 20<sup>th</sup> century, leading researchers contended that young children were mathematically inept and that early mathematics education was useless (Thorndike, 1922). In the 1960's, the development of Head Start (with its purpose of increasing academic preparedness) and the coinciding re-birth of cognitive psychology, saw the beginning of foundational research that focused on the mathematical aptitude (rather than the lack of mathematical capabilities) of young children. Despite this, before the turn of this century, intentional teaching of mathematics in early childhood was generally viewed as "developmentally inappropriate" (Balfanz, 1999; Ginsburg & Golbeck, 2004; Ginsburg, 2009; Greary, 1996; Hachey, *In Press [a]*; Sophian, 2004).

However, research in only the last decade or two has spawned a drastic shift (Hachey, *In Press[a]*). Today, there is a substantial body of developmental research that has found that young children engage in diverse mathematical thinking from birth. There is strong evidence that prior to elementary school, children naturally and intuitively begin to develop relationships between the real world, mathematical concepts, symbols and procedures (Gray & Tall, 2000; Mack, 2001; Nunez, Edwards & Matos, 1999). However, these intuitive foundational mathematics skills that children develop are often fragile and are not enough (Cross, Woods and Schweingruber, 2009; Hachey, *In Press [b]*; Sophian, *In Press*). Because of this, Early Childhood Mathematics Education (ECME) is now advocated to be vital for future mathematic and general academic success (Cross et al., 2009; Duncan et al., 2007; Samara and Clements, 2009).

## ECME TODAY

Mathematics during early childhood naturally happens; when a child says “I have lots more blocks than her” or asks “teacher, can we read two more books before snack time?”, they are using their intuitive mathematical knowledge. However, early childhood mathematics *education*—ECME-- is intentional (Hachey, *In Press [a]*). Intentional teaching is defined as: “adapting teaching to the content, type of learning experience, and individual child with a clear learning target as a goal” (Cross et al., 2009, p. 226). Thus, ECME means more than arranging the classroom materials or capitalizing on random teachable moments or just singing a song that has numbers in it. It involves the teacher purposefully designs learning opportunities that encourage children to explicitly think, talk and act on real-life experiences and problems in mathematical ways. Ultimately, the overall goal of ECME is to help children to meaningfully interpret foundational mathematical principles and to support the development of their fragile intuitive knowledge into the robust and transferable knowledge that marks sophisticated mathematical thinking (Ginsburg, 2009; Hachey, *In Press [b]*; Sophian, *In Press*).

The National Association for Young Children (NAEYC), The National Council of Teachers of Mathematics (NCTM) and research-based sources all advocate the intentional development of opportunities and environments whereby young children are able to learn and meaningfully practice big ideas (i.e. core knowledge) in each of five content areas: number and operations, geometry, measurement, algebraic thinking, and data analysis. This is counter to past practice, in which mathematics had a narrow scope that focused on numeracy; the expansion to five mathematical content areas serves to encompass more of the concepts critical for decision making in daily life (McCrone & Dossey, 2007). However, numeracy is still stressed as a critical foundational area, followed by the areas of geometry and measurement. In addition, parallel to intentional learning in the five content areas, ECME today includes the development of thinking and behavior processes. These are cited as: problem solving, reasoning and proof, communication, connections and representations (NCTM, 2006) and organizing information, patterning and composing (Clements, Sarama & DiBiase; 2004).

## TEACHER BELIEFS COUNT

Research supports that teacher behavior in the classroom is directly influenced by personal beliefs about what it is appropriate for children to learn and what is appropriate ways to teach them (for reviews, see Brown, 2005; Cross et al, 2009; Pajares, 1992; Vartuli, 1999). Because of this, teacher beliefs have been shown to be a major deciding factor in decisions about curriculum design, along with affecting teacher-child interactions and influencing the classroom environment (Lara-Cinisomo et al., 2009; McMullen, 1997). A linkage has long been made between teacher beliefs and mathematics education. Thompson (1984) contends that: “There is strong reason to believe that in mathematics, teachers' conceptions (their beliefs, views, and preferences) about the subject matter and its teaching play an important role in affecting their effectiveness as the primary mediators between the subject and the learners” (p. 105). Case studies of individual teachers and anecdotal evidence show that teachers have strong beliefs about mathematics and mathematics education (Cross et al., 2009). They indicate that in general, early childhood teachers: hold beliefs of fear and hate towards mathematics (Lee and Ginsburg,

2007a/b; Stipek, 2008) and do not place high value on and do not devote much time to teaching mathematics (Ginsburg, Lee and Boyd; 2008).

## TEACHERS AND ECME

There are two major ways that teacher beliefs may be influencing ECME (or a lack thereof) in early childhood classrooms today. First, it may be that because of dislike for the subject or a lack of value in it, early childhood teachers instead devote their time and efforts to other areas of instruction. Some findings suggests that early childhood teachers feel mathematics is difficult to teach and that language/literacy is the most important academic content for early childhood (Copley, 2004; Ginsburg; 2009). This is supported by Early et al. (2005), who found that 21% of early childhood classroom time is spent on literacy-based activities, whereas only 8% of instruction time is devoted to mathematics-based activities. In addition, other findings indicate early childhood teachers seem to hold beliefs that social-emotional and physical development are more important for young children's development than instruction focused on academic subjects (Cross et al., 2009; Ginsburg, Lee and Boyd 2008).

Second, it may be that teacher's belief on the nature of ECME remains narrow in scope, with the focus still mainly on numeracy. Copley (2004), Ginsburg (2009) and Starkey et al. (2004) report findings that even early childhood teachers who state that they value and devote time to mathematics instruction do not include all five of the content areas; they instead still engage in direct mathematics instruction limited to counting and simple arithmetic activities. Moreover, current teaching practice has been shown to focus on the rote memorization of discrete skills and factual knowledge (Early et al., 2005), rather than including real-world problem solving that would NCEDE (2005) allow for the development of mathematical thinking and behavior processing skills.

## A STUDY OF EARLY CHILDHOOD TEACHER BELIEFS ABOUT ECME

Hachey (*In Press [c]*) conducted a study examining early childhood teachers' beliefs about the role of mathematics in the early childhood classroom. Data were collected via a survey. The survey asked a range of questions that addressed a) the teachers' feelings' about mathematics; b) the teachers' beliefs about ECME and 3) asked for information on ECME in their teaching practice.

### Findings of the Study

Findings from the study suggest that early childhood teachers may not hold a view about mathematics and ECME as overwhelmingly negative as has been expressed in previous studies. However, a large portion of participants responded with neutral attitudes towards mathematics and ECME. As young children tend to internalize their teachers' enthusiasm or lack of enthusiasm for a subject (Jackson and Leffingwell, 1999), these neutral attitudes are noteworthy. Neutral attitudes still may result in teachers devoting more instructional time to areas they feel

more positive towards or in teachers unconsciously modeling a lack of conviction in the importance of mathematics, which can be detrimental to students (Hachey, 2009).

Another finding from the study is that more classroom time seems to be devoted to ECME than has been previously found, with the majority of participants indicating they spent 11-50% of their week engaged in formal mathematics activities. This rise in reported ECME practice may be a reflection of the recent ECME national policy movement and offers some hope that ECME is gaining more attention in early childhood classrooms. However, the results also support the contention teachers have stronger beliefs in the importance of literacy instruction and that literacy-based activities dominate the time devoted to academics in early childhood classrooms. In fact, in this study, literacy instruction time even out-paced instructional time devoted to social development, the reverse of which has been reported previously (Ginsburg, Lee and Boyd, 2008).

In the study, teachers also expressed a narrow view of ECME, with numeracy and arithmetic skill stated as the most important focus of ECME. This supports the literature (Copley, 2004; Ginsburg, 2009; Starkey et al.; 2004), which indicates that even those who express beliefs in the importance of ECME still tend to only focus on numeracy. This finding is problematic, as substantial developmental research contends that young children are capable of learning broad areas of mathematics, and further, that they should be instructed in a wide and complex range of mathematical activities (Ginsburg, Lee and Boyd, 2008; Lee and Ginsburg, 2009). The finding of early teachers still holding a narrow view of ECME strongly suggests that there is still a distinct disparity between current teacher beliefs and practice and leading ECME guidelines and recommendations.

Also counter to current recommendations for ECME and supporting previous research (Ball, 1995; NCEDL, 2005), the findings indicate that teachers may hold beliefs about ECME that is didactic in nature (focused on mastering skills and/or procedures). This focus on skill and procedure is related to the use of counting and arithmetic activities, which teachers indicated dominated their ECME instruction time. However, traditional ways of teaching which focus on rote memorization are in opposition to the current recommendations for ECME; the leading recommendations call for meaningful, real-world types of mathematical problem solving that allow for the practice of foundational mathematics knowledge, while also building related thinking and behavior processing skills and fostering continued interest in mathematics (Cross et al., 2009; Hachey, 2009; Hachey, *In Press [a]*). Thus, although overall, the study results indicate that early childhood teachers may be devoting more instructional time to ECME, the content and methods of instruction still may not be optimal. This raises the concern that more harm may be being done than good.

## IMPLICATIONS AND APPLICATIONS FOR PRESCHOOLS

It seems that teachers generally still have stronger beliefs in the importance of literacy over mathematics. And, because of this, literacy-based activities dominate academic instructional time in the preschool classroom. However, recent research contends that in fact, the opposite may be true.... mathematics ability at the beginning of kindergarten has now been shown to be a strong predictor of later general academic success, even more so than early reading ability (Duncan et al., 2007). This is not to say that early literacy instruction is unimportant, but that

early mathematics instruction should receive just as much focus and development in the preschool classroom.

The second implication is that what was deemed mathematics in the past (i.e. rote memorization activities that focused on counting and numeracy), will not serve with today's expanded version of ECME. Current developmental research holds that preschoolers are capable of engaging in mathematical thinking related to geometry, measurement, algebraic thinking and data collection. Moreover, researchers advocate for preschool teachers to intentionally engage young children in meaningful, real-world types of mathematical problem-solving that allows them to build mathematically-related processing skills in multiple domains (Cross et al., 2009; Hachey, *In Press*). Yet today, because teachers may still hold narrow beliefs of what constitutes mathematics and further, seem to be over-relying on “copy and practice what the teacher does” methods of instruction, ECME is known to generally be ineffective (Ball, 1995; Stipek, *In Press*). In order for ECME to evolve to reflect current researched recommendations, this means that preschool teachers will need to expand their beliefs of what early mathematics is and how it should be taught.

## WHAT TEACHERS CAN DO

There are two key issues for teachers. First, teacher beliefs about ECME are a critical factor influencing instructional practice and as such, require personal introspection. As Palmer (2012) explains, we teach who we are: “Teaching, like any truly human activity, emerges from one's inwardness, for better or worse. As I teach, I project the condition of my soul onto my students, my subject, and our way of being together”. Feelings of mathematics anxiety and failure have been shown to persist into adulthood (Tobias, 1993). Such feelings can engender a lack of confidence in the ability to use mathematics correctly or a lack of interest in engaging in ECME (Harper and Daane, 1998). So, preschool teachers can begin by critically examining their own beliefs about mathematics and how old mathematics-related emotional baggage may be influencing their teaching practice (Hachey, 2009). This could involve reflective journaling on their past school mathematics experiences, on their curriculum development process and on past and current classroom interactions.

The second key issue for teachers is capacity building; ECME will not achieve the desired impact if early childhood teachers do not invest in becoming teachers of mathematics (Hachey, *In press [b]*; Stipek, *In Press*). This means devoting the time and effort needed to learn about the early mathematical development of young children and the current guidelines for teaching and learning early mathematics. Articles and workshops from the National Association for the Education of Young Children (<http://www.naeyc.org/>) and the National Council of Teachers of Mathematics (<http://www.nctm.org/>) are available, along with several valuable resources for research and exploration of ECME (see Cross et al.; Hachey, 2009; Samara & Clements, 2009). It also means then applying this knowledge in teaching practice. This includes making pre-planned curriculum decisions about mathematical goals and content, instructional methods and authentic assessments. This can be supported by teachers forming colleague curriculum discussion groups, as collaborative problem-solving may help identify opportunities for changes in daily schedules, activities, material use and the learning environment that will help facilitate a wide variety of mathematic learning opportunities in the classroom.

## CONCLUSION

A study of early childhood teacher beliefs about mathematics and ECME was conducted. The results show that teachers may not hold as negative views about ECME and seem to be engaging in more ECME in the classroom. However, this is tempered by findings that suggest that ECME practice may be counter to current guidelines, both in scope and methods of instruction. ECME will only become optimal when preschool teachers critically examine their beliefs and begin adopting teaching practices based on the latest research-based recommendations.

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