

# Early childhood mathematics teaching



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Mathematics is one subject that unleashes deep-seated memories for many people. Most of these memories include the learning of mathematical concepts and skills. Such learning may either be fulfilling or frustrating for learners, as Math covers a wide variety of degrees of difficulty. That is why an effective Math teacher can have so much influence over students in learning and even loving the subject. An effective Math teacher should be able to model to her students her enthusiasm for the discipline that she takes teaching it seriously while according due respect to her learners who may not exhibit the same level of competencies for the subject.

Preschool is a time when children may first encounter mathematical lessons, however, much recent research has indicated that preschool children have the ability to understand a variety of mathematical concepts even prior to entering kindergarten (Klein, Stakey, Clements, Sarama, & Lyer, 2008; Clement & Sarama, 2007). That is why early childhood programs are increasingly required to implement mathematics instruction in classrooms because of young children's early mathematical knowledge. Development of early math skills provides the foundation for later learning (Clements & Sarama, 2008; NAEYC & NCTM, 2008; Lee & Ginsburg, 2008).

According to the National Council of Teachers of Mathematics, the quality of mathematical education in early childhood plays an important part in the child's understanding of possibly difficult math concepts (Loop, 2009).

Although there had been many studies pertaining to patterns of mathematical teaching in preschool, there is a lack of research on how teachers of Math perceive how young children learn Math and even what to teach in accordance to the developmental level of their learners.

This current study draws much inspiration and idea from the work of Platas (2008) entitled “ Measuring Teachers’ Knowledge of Early Mathematical Development and their Beliefs about Mathematics Teaching and Learning in the Preschool Classroom”. Platas was able to measure the knowledge of early mathematical development and beliefs about mathematics teaching and learning in the preschool classroom of preschool teachers using developed and validated survey instruments and statistical analysis (2008). There was a significant variation in the knowledge and beliefs of early childhood teachers on age-appropriateness of math instruction, classroom locus of generation of mathematical knowledge, math versus socio-emotional development and the comfort level in providing the instruction. The instrument used in the research has been found to be helpful for the preparation of prospective Math teachers as well as for the professional development of current Math educators.

Platas’ work has raised many issues and beliefs regarding the developmental knowledge of preschoolers. Such issues include age-appropriateness of mathematical instruction used by teachers in preschools, the extent of learning of such mathematical concepts taught, the purpose of teaching math concepts in preschool and the comfort level of teachers when they introduce such math concepts to preschool children (Clement & Sarama, 2007; Ginsburg & Golbeck, 2004; Platas, 2008).

#### **DEFINITION OF TERMS:**

Belief – “ covers all the matters of which we have no sure knowledge and yet which we are sufficiently confident of to act upon and also the matters

that we now accept as certainly true, as knowledge, but which nevertheless may be questioned in the future” (Dewey, 1933, p. 6).

early mathematical development – “ the increasingly complex mathematical constructions and goals that young children develop and pursue in their activities”

(Platas, 2008, p. 3).

In-service preschool teachers – teachers who are currently teaching in the preschool level of education.

Pre-service preschool teachers – aspiring teachers of early childhood education who are qualified to teach but have not yet gained any teaching experience.

### **STATEMENT OF THE PROBLEM**

Many national and state organizations have provided teachers with guidelines to help improve mathematics instruction for young children. Forty-six states have comprehensive learning standards for preschool children (Barett et al., 2008). Furthermore, national organizations such as the National Association for the Education of Young Children (NAEYC) and National Council of Teachers of Mathematics (NCTM) have developed specific recommendations related to high quality mathematics instruction in the early childhood classroom (NAEYC & NCTM, 2006). As the NCTM and NAEYC proclaimed, importance in the learning and development of mathematical skills and knowledge is important in building the foundation of mathematical development of preschool children. However, some early learning programs

do not focus on high quality mathematics instruction despite research supporting early mathematics experiences influencing mathematical outcomes later in school and promoting school readiness skills in mathematics (Lopez, Gallimore, Garnier, & Reese, 2007; Slaby, Loucks, & Stelwagon, 2005).

Other remarkable studies showed that there are many activities involved in teaching mathematics to young children and this would involve knowledge about the subject matter, pedagogical content knowledge, lecturing, introduction of symbolism, and connecting everyday experience to abstract ideas (Ginsburg & Amit, 2008). This would imply the need to effectively train teachers of early mathematics.

There are many significant studies in line with early childhood education but little information is revealed about the teaching of early mathematics (Ginsburg & Amit, 2008). This gap in research in mathematics education calls for the need to be filled especially in the area of teachers' knowledge development and beliefs in teaching math in preschool.

The only remarkable research in the area of teachers' knowledge on preschool mathematical development is that of Platas (2008). Platas suggested in her recommendations, further study is still needed in the area taking into consideration a larger sample size and other necessary adjustments (2008).

The need for preschool children to be provided with high quality early childhood programs calls for competent educators in general. Specific to this

study, competent math teachers concerned with the development of mathematical ability of preschoolers are the qualifications demanded.

It is in this regard that early childhood educators in mathematics should create the basic foundation required in the education system. This can significantly create meaningful understanding on how pre-service teachers and in-service teachers in early childhood education for mathematics should handle and evaluate their teaching abilities and methods. However, it remains uncertain whether pre-service teachers and in-service teachers in early childhood education for mathematics have significantly the same knowledge of mathematical development and belief. Thus, it is important to evaluate their knowledge of development and belief about it so as to come up with a clear justification if there is a need to align their level of skills, knowledge and beliefs if necessary.

Even though Platas (2008) was able to compare early childhood teachers based on their knowledge of early mathematical development and beliefs about mathematics teaching and learning in the preschool classroom, there was no comparison done between pre-service and in-service preschool teachers in this regard. The researcher believes that this research gap needs to be filled since future and current teachers' knowledge and beliefs will inevitably create an impact in young children's mathematical knowledge development. It would be interesting to determine if experience in teaching of in-service teachers have affected their knowledge and beliefs on mathematical knowledge development and beliefs or if they remain the same as their pre-service counterparts. Hence this study will analyze and

review in-service teachers' and pre-service preschool teachers' understanding on mathematical knowledge development and beliefs

### **PURPOSE OF THE STUDY**

The purpose of this study is to examine and compare the mathematical development and beliefs in preschool learning between in-service preschool teachers and pre-service preschool teachers. The comparison will gauge the need to enhance the teachers' knowledge of mathematical development and beliefs in early childhood education. Further development of these teachers' adeptness in mathematical knowledge as well as fine tuning their beliefs will be done in the backdrop of the literature in preschool math development.

### **RESEARCH QUESTIONS**

The researcher will compare and evaluate in-service teachers and pre-service preschool teachers' knowledge and beliefs of mathematical development and teaching. In order to find significant results for this, the researcher will try to answer the main research question at of the study:

**To what extent, if any, is there a difference between In-service teachers and pre- service preschool teachers with regard to their knowledge and beliefs of how to teach mathematics to preschool children?**

Specifically, the following sub-questions will be answered at the end of the study:

- What do the teachers think are the necessary concepts and skills preschoolers need to learn in the area of math?
- What teaching methods do the teachers think are effective in teaching these mathematical concepts and skills?

- What are their beliefs regarding teaching math?

## **HYPOTHESIS**

It is hypothesized that there are significant differences between the beliefs of in-service and pre-service preschool teachers on the basis of experience.

Those who have experiences in the teaching mathematics will have a different perspective basing from their own experiences compared to those who have limited or no experience in teaching mathematics to preschool children.

It is also hypothesized that there are significant differences in the knowledge of mathematical development between in-service and pre-service preschool teachers.

## **REVIEW OF LITERATURE**

### **What Preschool Math Entails**

The study of Math incorporates the processes of questioning, reflecting, reasoning and proof. It is a powerful tool for solving familiar and unfamiliar problems both within and beyond mathematics. As such, it is integral to scientific and technological advances in many fields of endeavor (Brewer, 2001). The inclusion of Mathematics in the curriculum is aimed at developing students' mathematical thinking, understanding, competence and confidence in the application of mathematics, their own creativity, enjoyment and appreciation of the subject and their engagement in lifelong learning (Board of Studies New South Wales, 2002)

Apart from the skills developed from the study of Math, values and attitudes are likewise emphasized. Students get to appreciate mathematics as an



essential and relevant part of life. They show interest and enjoyment in inquiry and the pursuit of mathematical knowledge, skills and understanding. Children demonstrate confidence in applying mathematical knowledge, skills and understanding to everyday situations and the solution of everyday problems. Math also aims to develop and demonstrate perseverance in undertaking mathematical challenges. Students recognise that mathematics has been developed in many cultures in response to human needs (Board of Studies New South Wales, 2002).

The National Council of Teachers of Mathematics (2000) identified high quality mathematics programs for early childhood as having the following characteristics: (Brewer, 2001, pp. 319-320)

“ They build upon and extend children’s intuitive and informal mathematics knowledge”

“ They are grounded in knowledge of child development”

“ They provide environments that encourage children to be active learners, eager for new challenges

“ They develop a strong conceptual framework that provides the foundation for skills acquisition”

They nurture and develop children’s inclination to solve problems.”

### **Math Teaching Strategies in Preschool**

Children learn much on their own. However, the question of whether certain math concepts should be deliberately taught by the teacher or just be freely

learned by children through play is another issue in math learning (Clement & Sarama, 2007; Ginsburg & Golbeck, 2004; Platas, 2008).

Shaftel, Pass and Schnabel (2005) agree that children are more motivated to learn even difficult lessons in Math or other subjects through instructional games and simulations rather than traditional classroom instruction. Games have been found to result in improved content retention over time, possibly because of the opportunity for more participation. Math games improved on-task behavior and achievement even for students with mild intellectual disabilities (Beattie & Algozzine, 1982).

What motivates children with math games is that it allows them many opportunities to reinforce current knowledge and to try out other strategies or techniques without fear of getting the wrong answer. Trial and error is always encouraged, making them more confident in taking risks (Shaftel, Pass and Schnabel, 2005). Math games provide students with an environment for experiencing incorrect answers not as mistakes but as necessary steps towards connecting pieces of knowledge together (Holton et al, 2001; Quinn et al, 1992). Practical games such as those involving knowledge about money should be tied to real-life experiences if mathematical learning is to be optimized. Simulations develop metacognitive skills for analyzing and organizing data, checking responses, justifying solutions to problems and applying mathematical knowledge to daily activities (Hopkins and Dorsey, 1992).

### **Issues of Teachers Teaching Math in Preschool**

This study is also concerned about the commitment of teachers in teaching math to young children (O'Connor, 2010).. It is essential to investigate if they know the value of teaching math concepts to preschoolers at a very young age, which math concepts to teach and if it is worth teaching such concepts. It would also be interesting to know how comfortable these teachers are in teaching Mathematics and what are their attitudes and insights towards it.

Teachers derive their behaviors, attitudes and ethics from their own personal and professional philosophies on teaching. Gore (1997) analyzes how such a philosophy leads to one's development of a pedagogical approach. A school having its own philosophy should have their teachers who hold the same beliefs. Alignment of their philosophy is essential for harmony. Gore (1997) claims that systematic and disciplined observations of pedagogy are necessary in order to clarify and perhaps compromise on the philosophy everyone must believe in and live by. This implies that a teacher's perception of teaching a particular subject such as Math reflects her own and the school's philosophy regarding the subject.

Many researchers have been intensively studying young children's mathematical development and have come to understand the developmental progression of children's

mathematical understanding (Baroody, A. J., Lai, M.-L., & Mix, K. S, 2006; Clement & Sarama 2007; Seo & Ginsburg, 2004). In order to support early mathematical development in young children, researchers recommend that teachers (a) develop a deep understanding of the mathematical content and

concepts (Baroody, et al., 2006); (b) develop an understanding of young children's mathematical development, including the ability to take into consideration the prior knowledge of the child (Baroody et al., 2006; Clement, 2001 & Clement & Sarama 2007); and (c) be fluent in the classroom pedagogy that supports and fosters such development including a knowledge of useful representations and strategies and common misconceptions and errors (Baroody, et al., 2006; Seo & Ginsburg, 2004).

By increasing teacher's knowledge and understanding of mathematical knowledge development, it is expected that children will also learn better and a more productive classroom atmosphere is will be created. Therefore, it is important for teachers to know how to support children's mathematical development in the preschool classroom in order to develop effective and appropriate classroom instruction. Teachers also need to understand how children learn mathematical knowledge as well as assessing their understanding, and monitoring their progress.

Apart from the information yielded by Platas' (2008) work, the literature point out that preschool teachers need to have a specific level of competency in their teaching which can be measured through their knowledge and beliefs. It was found that kindergarten teachers' different training experiences and school contexts have significant impacts on children's readiness for school (Lin, Lawrence, & Gorrell, 2008). This implies that the level of knowledge and beliefs of preschool teachers have been significantly influenced by their training experiences and level of education received. Preschool teachers have different views on early childhood

education with some of them thinking the programs in their schools may either be too advanced or too basic.

Teachers' preparation for cultural diversity in preschool is important prior to creating a welcoming learning environment (Hughes, & Kwok, 2007). Skills and knowledge of teachers are important considerations especially on the basic education level. Teachers' gestures and utterances were found to have a significant role in children's learning (Klerfelt, 2007, Valenzeno, Alibali, & Klatzky, 2003). In preschool education, high quality teacher-child relationships are expected. Knowing how to establish such good relationships with young children implies that the preschool teacher must have substantial knowledge on relationship building in early childhood education programs (O'Connor, 2010). This also suggests that the teacher is effective and knows how to infuse fun in learning.

Preschool teachers must have adequate knowledge and strong beliefs in a particular subject area they are tasked to teach. They should have knowledge of useful representations and strategies and common misconception errors when it comes to mathematical development in young children in particular (Broody et al., 2006). A Development model that coincides with theory and research is needed to create the building blocks for early childhood mathematics (Sarama, & Clements, 2004). On the other hand, a teacher's belief is hard to measure but it proves a reliable measure of teacher's experiences and actions (Muis, Bendixen, & Haerle, 2006). For example, a teacher may believe that young children are capable of understanding quantities because she herself has been successful in teaching a preschooler the concept of quantities, of which set has more

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objects and which set has less. Thus, knowledge and beliefs of teachers are requirements for mathematical development in early childhood education.

Education and specialized training of preschool teachers are associated with young children's learning and development (Barnett, 2004). Evaluation of the impact

of Early Childhood Education teacher preparation programs and professional development conclude that benefits of high-quality preschool education can only be achieved if teachers are professionally prepared and well-compensated (Barnett, 2004). Research shows that a well-prepared early childhood education teacher brings a warm, safe and conducive environment for learning (NAEYC, 2006). Perceptions of teacher on student-teacher quality and of children's academic abilities proved to influence academic competence among students (Hughes, Gleason, & Zhang, 2005). In addition, it is important to focus on quality of room practices, child characteristics, teachers' perceptions of school-related climates and teachers' perceptions of workload stress (Mantzicopoulos, 2005). It was found that the amount of teacher's math-related teaching was highly associated to children's mathematical knowledge (Klibanoff, Levine, Huttenlocher, Vasilyeva, & Hedges, 2006). The attitudes of preschool teachers on early mathematics do not change as they acquired knowledge of preschool teachers (Alinsinanoglu, Guven, & Kesicioglu, 2009). Teachers' elementary education credentials, years of education and years of experience have complex impact to children's learning (Connor, Son, Hundman, & Morrison, 2005). All of these issues can essentially be addressed by studying further within the context, knowledge and ability of early educators for early childhood education.

## **SIGNIFICANCE OF THE STUDY**

This study takes on Platas' suggestion that more research should be done in terms of investigating preschool teachers' knowledge and beliefs regarding the developmental mathematical knowledge of preschool children. In compliance with the standards of NCTM for high quality math programs, evaluation of teachers' competencies should be done to ensure the quality of teaching in early childhood programs.

This study's significance lies in ensuring that teachers are adequately skilled and emotionally ready to teach mathematical concepts in the preschool level. In addition, this study is a contribution to the growing body of knowledge of early childhood education. Furthermore, new information may be derived from concerned participants in this research such as fresh ideas coming from the perspective of in-service and pre-service teachers that could be helpful in improving one's performance in their jobs.

Thus, the importance of pursuing this trend of thinking will highly benefit teachers in early childhood education. In particular, there is a need to publish studies such this in order to provide support and enhancement of skills to new teachers in the field. It is important to study perceptions of early childhood educators because they play a significant role in young children's learning and development of knowledge and skills (Chien, & Hui, 2010).

This study will help not only teachers to better understand the learning process involved in order to maximize mathematical knowledge development of young children. It is also helpful in building a better mathematical foundation for young children.

## **OVERVIEW OF METHODOLOGY**

Instruments to be used for this study are the instruments developed by Platas (2008) namely the Knowledge of Mathematical Development (KMD) Survey and the Beliefs survey. A demographic questionnaire gathering information about the respondents will also be distributed.

The Knowledge of Mathematical Development Survey (Platas) is a set of 20 multiple-choice questions that tests teachers' knowledge and development in the area of verbal counting sequence, counting, ordinal number of words, addition/subtraction, divisions of sets, written number symbols and words. In each number, the teacher-respondents are to choose which of two math skills children are likely to learn first. If the respondents think that both choices are easily learned by a child, then the choice of " same" may be picked. However if the respondent does not know which skill is easier for a child to learn, he or she can choose the option " do not know".

The Beliefs Survey is a set of 40 beliefs about Math teaching and learning. It has a 5-pt. Likert scale with responses that range from Strongly Agree to Strongly Disagree. The belief survey will evaluate the teacher's perspective about 4 areas: (1) age appropriateness of mathematics instruction in the early childhood classroom, (2) locus of Generation of Mathematical Knowledge, (3) Social and Emotional vs. Mathematical Development as Primary Goal of Preschool and (4) Teacher comfort in mathematics instruction.



The participants involved in the study will be comprised of 200 in-service teachers and 100 pre-service teachers that will be chosen in random. Results will be analyzed using ANOVA as well as correlation analysis.

## **LIMITATIONS OF THE STUDY**

This study will be limited to exploring the knowledge development and beliefs of pre-service and in-service preschool teachers regarding math. It will not evaluate on any other subject area. It is important to note that in terms of experience, the pre-service teachers will have no teaching experience whereas with the in-service teachers' experience may range from a few months to about 20 years, depending on the sample gathered. Also, the number of in-service participants is much higher than the pre-service participants. These factors may affect the results due to this unbalance and must be taken into account when data is analyzed.

## **Summary of Chapter 1**

Mathematical learning now comes at an earlier age. Preschoolers surprisingly manifest basic mathematical knowledge even before they start school. This realization that young children can already “do” Math has encouraged professional organizations such as NAEYC and NCTM have come up with guidelines that Math teachers should consult and comply to in their teaching of mathematical concepts and skills.

Teachers of young children have the power to influence their preschool students. Teachers should basically possess adequate knowledge and skills as well as appropriate beliefs if quality teaching is to be expected. The work of Platas (2008) entitled “” Measuring Teachers' Knowledge of Early

Mathematical Development and their Beliefs about Mathematics Teaching and Learning in the Preschool Classroom” has been a monumental inspiration for this current study. However, this study goes beyond exploring teachers’ knowledge development and beliefs about Math by comparing knowledge development and beliefs of in-service preschool teachers and pre-service preschool teachers. It is presumed that the element of experience will play a significant role in either strengthening or modifying teachers’ knowledge and beliefs about Math in early childhood education.