

# Math Counts: Issues That Matter

A PROFESSIONAL SERIES, VOLUME 7

## PRE-KINDERGARTEN MATHEMATICS



The pre-Kindergarten years are a time of immense growth for children. They grow both cognitively and physically while working to socially determine their place in their surroundings. Cognitively, children begin to use their abilities to reason, think logically, solve problems, and communicate with others about ideas. During this early childhood period, mathematical development is fundamental for children to have high-levels of success later in school. Pre-Kindergarten children should be encouraged to think in mathematical ways to build the foundations for later learning. These foundations do not have to be built from scratch, however. Before entering school, many children have developed early skills in number sense and geometry from experiences such as counting objects or using building blocks. "[Pre-Kindergarten children] use mathematical ideas in everyday life...It would be an

educational shame not to nurture such interests" (Clements, *Mathematics*). A pre-Kindergarten mathematics program encourages further development of mathematical thinking and reasoning.

### Developing Mathematical Awareness

A primary goal of pre-Kindergarten classrooms should be to build mathematical awareness and to develop a beginning level of understanding about mathematical concepts. A pre-Kindergarten mathematics program needs to focus on teaching the whole child; the cognitive, social, emotional, physical, and civic sides, as well as addressing the multiple intelligences. In pre-Kindergarten children's learning

*A pre-Kindergarten mathematics program needs to focus on teaching the whole child; the cognitive, social, emotional, physical, and civic sides, as well as addressing the multiple intelligences.*

proceeds naturally from children's daily lives when they interact with objects, ideas, and people to build knowledge through exploration. To foster such development, a pre-Kindergarten math program uses methods that allow for exploration: literature, hands-on activities, and centers help to promote mathematical understanding in an exploratory environment.

## Literature

Literature is a natural springboard to use to develop mathematical concepts in young children. "When sharing books, teachers can provoke mathematical thinking through questioning or by just allowing time and opportunity for students to respond spontaneously to the ideas in the story" (Lewis et. al). Many books, while they may not be written for the purpose of teaching mathematics, express mathematical ideas in a manner that children can relate to. For this reason, "teachers who share literature regularly have at their fingertips a natural, meaningful context for encouraging students to talk and write about mathematics" (ibid.). Through literature, children and their teachers can communicate mathematical ideas and understandings, which are essential to developing math skills.

## Hands-On Activities

As stated above, pre-Kindergarten is a time of physical and cognitive growth for children. Children are starting to use their abilities to think, reason, problem solve, communicate, and interact with other people. At this age, children are visual and concrete learners, they have not yet developed abstract thinking, and so hands-on activities are essential for learning. Hands-on math activities provide opportunities for children to talk, write, sing, play, and act out mathematical concepts everyday. Further, research has shown that students who are exposed to concrete, hands-on activities have better attitudes towards mathematics and increases concept retention and problem-solving abilities (Stowell). The key to successful hands-on activities is to make sure children understand the activity, that they are not just doing it in a rote manner. To reach this goal, hands-on activities should be accompanied by communication between the teacher and student as well as peer communication. This type of support helps to clarify the mathematical ideas in children's minds, it makes children aware of mathematical ideas.

## Centers

Centers are useful for children to experience mathematics as they play in and explore their world. Often in educational settings prior to first grade, learning is often informal. "This does not mean unplanned or unsystematic. The child's environment should encourage the elicitation of pre-mathematical activities" (Clements, *Playing*). Centers allow for children who have a wide range of abilities and learning styles. As with hands-on activities, effective communication between teachers and children is necessary for the center activity to be productive. This communication should help students develop a mathematical understanding of what they are doing in the center, without being too abstract. By so doing, children develop a basis of understanding mathematics.

## Universal Access

Research has shown that "children who experience high-quality early childhood education have a better chance of achieving high levels than those who do not" (Clements, *Playing*). This research has been proven on both advanced learners and low-performing children as well as children from various socio-economic backgrounds. Therefore, accommodating a wide range of abilities and learning styles is essential for any pre-Kindergarten mathematics program. Support activities should provide a downward

extension for children who are not ready for the task at hand. Challenge activities should provide an upward extension to broaden children's mathematical understanding. By providing downward and upward extensions, teachers can bring the pre-Kindergarten program to a level where children can succeed in mathematics. When a pre-Kindergarten mathematics program is accessible to all learners, it helps to ensure their own personal success in mathematics later in school.

## Role of the Educator

The teacher's role in pre-Kindergarten is multifaceted. A teacher's job is "to continually provide a rich environment with a wide variety of experiences, [to] carefully observe children's pursuits, and then [to] offer more resources and scaffolding to deepen and extend their learning" (Carter). Teachers can use three methods to encourage mathematical thinking in the classroom. First, they can create situations that are personally meaningful to children. Studies have shown that children learn best when

they relate ideas to what they already know (Clements, *Playing*). Second, decision-making opportunities may be provided for children to develop problem-solving skills. Third, moments for peers to exchange ideas are also useful for encouraging mathematical thinking. It is important to remember that there are math concepts around children every day. Teachers need to "expand their own thinking of mathematical concepts—temporal, spatial, measurement, classification, as well as those of quantity and counting" that can be used to encourage mathematical thinking (Clements, *Mathematics*).

*A pre-Kindergarten mathematics program that stems naturally from children's daily lives and encourages understanding through exploration and communication allows children the opportunity to develop a strong awareness of mathematics.*

## Assessment

Assessment options are necessary to ensure each child's success and progress. However, assessment options at the pre-Kindergarten level are most often observation techniques. For example, after working on patterns, observing a child in a center creating a pattern out of blocks. Another child in the same center may note that the blocks "are red then blue"—showing that the child has seen a pattern in his or her daily life. Such observations should be noted and recorded on a progress report so that both educators and parents know student progress. An added benefit to such observational assessment is that it informs instruction. If students are repeatedly making the same error, teachers can modify instruction to help correct the error. Progress

reports and parent letters provide structure to assessment and ensure that student progress is monitored by educators and shared with the family.

"Children should move developmentally, building upon the skills and knowledge of yesterday's learnings, integrating today's experiences, and going forward to meet tomorrow's challenges" (3, 4, Open the Door). A pre-Kindergarten mathematics program that stems naturally from children's daily lives and encourages understanding through exploration and communication allows children the opportunity to develop a strong awareness of mathematics.



### Douglas H. Clements

is Professor of Mathematics, Early Childhood, and Computer Education at the State University of New York at Buffalo, where he also earned his Ph.D. in Elementary Education. Dr. Clements conducts research on computer applications in education, early development of mathematical ideas, and the learning and teaching of geometry.

## Bibliography

Carter, Margie. "Making Learning Visible." *Child Care Information and Exchange*. July 1999, pages 35-37.

Clements, Douglas. "Mathematics in the Preschool." *Teaching Children Mathematics*. 2001, volume 7, pages 270-275.

Clements, Douglas. "Playing Math with Young Children." *Curriculum Administrator*. 1999, volume 25, pages 25-28.

Lewis, Barbara A., Robert Long, and Martha Mackay. "Fostering Communication in Mathematics using Children's Literature."

*Arithmetic Teacher*. April 1993, pages 470-473.

Stowell E.J. "Effects of Manipulative Materials in Mathematics Instruction." *Journal for Research in Mathematics Education*. 1989, volume 20, pages 298-505.