Nature As a Path to Early Math

by Gwendolyn Johnson and Ruth A. Wilson

The curriculum in most preschool programs tends to focus primarily on language, early literacy, and social-emotional development. An academic area that is frequently neglected is mathematics (Cross, Woods, & Schweingruber, 2009). Yet, recent research shows that children's mathematical ability when they enter kindergarten is a better predictor of later school success than their reading ability (Duncan et al., 2007). What's especially surprising is the fact that early knowledge of math not only predicts later success in mathematics, but is also a better predictor of later reading achievement than early reading skills (Duncan et al., 2007).

In response to school readiness concerns, a number of states (including NY, IL, AZ, CO, PA, WI, CA, and OH) have developed early learning standards, which include mathematics. Colorado's early math standards focus on two areas:
a) number sense, properties, and operations; and
b) shapes, dimension, and geometric relationships.
The related math expectations are as follows:

Number sense, properties, and operations	Quantities can be represented and counted.
Shapes, dimension, and geometric relationships	Shapes can be observed in the world and described in relation to one another. Measurement is used to compare objects.

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These areas and related expectations are typical of early math standards in other states. They are also consistent with the Common Core Standards developed for K-12 programs.

An awareness of early math expectations is a matter of concern for many early childhood teachers. They may be unsure about what each area encompasses and have little understanding about how to help young children develop related mathematical skills (Dockett & Perry, 2002).

In addition to teachers' own misgivings about how to teach math to young children, another reason why math is often neglected in early childhood education programs is the mistaken belief that young children may not be able to learn the related concepts and that introducing math to young children is not developmentally appropriate (Golbeck, 2001). This thinking is based on the idea that math is too formal, abstract, and theoretical for young children. Teachers' own fear of and aversion to math may be an additional obstacle (Ginsburg, Lee, & Boyd, 2008).

Another reason why math instruction is often neglected in early childhood programs relates to limited opportunities for teacher training in this area and a lack of resources. Fortunately, this is beginning to change. Some published pre-K curricula now include mathematics as a critical component of their program. The 5th edition of *The Creative Curriculum for Preschool* (Heroman & Dodge, 2010) is one example. Additionally, complete stand-alone pre-K math curricula are also available. *Building Blocks — Real Math PreK* (Clements & Sarama, 2007) is an example.

Understandings and Guidelines

Understanding what math is and what it is not can help teachers become more confident in teaching math to young children. One basic understanding is that math is everywhere in our lives. As we cook, shop, and travel, we use math relating to measurement, money, time, and distance.

Young children use math as they study the shape and size of different objects and as they sort materials into different categories.

It's also important for teachers to understand that basic literacy — a critical component of early childhood education — consists of both reading and mathematics. Math literacy includes the ability to understand such terms as *total, altogether, more*, and *less*. Math literacy also includes having the ability to problem solve, reason, and analyze information.

Teachers also need to understand that guided math experiences can be developmentally appropriate for young children. We all know that one of the key principles in early childhood education is the importance of developmentally appropriate practices (DAP). This principle basically means that instruction at the early childhood level needs to be based on an understanding of and respect for both the age and the individual needs of each child. With DAP in mind, it follows that math instruction for young children will differ in both content and process from math education for older students. Presented below are some guidelines on how to be developmentally appropriate in fostering mathematical thinking and skills in young children:

Keep it positive. Work from the premise that young children are eager learners and that they're interested in everyday mathematics and how it's used.

Capitalize on naturally-occurring situations, including child-initiated play activities. Research has shown that opportunities for math education often occur during children's play and self-directed explorations, yet math thinking during play often gets overlooked (Parks & Blom, 2013).

Give children opportunities to achieve success in math-related activities, as feeling capable and competent plays a significant role in achieving math literacy. Positive experiences with math will promote children's confidence in their ability to understand and use mathematics. These positive experiences also help them develop other dispositions important to future success in and out of the school setting. These dispositions include curiosity, flexibility, inventiveness, imagination, and persistence (National Council of Teachers of Mathematics, 2014).

Keep it hands-on. Most math activities for young children should be three-dimensional and invite hands-on manipulation.

Integrate math learning with other areas of investigation and learning. Mathematical learning should occur throughout the day and in all areas of the curriculum.

Avoid underestimating children's ability to think mathematically. Young children can understand mathematics in complex ways. They can grasp basic concepts of number and operations, geometric shapes, spatial relations, measurement, and patterns (Ginsburg, Lee & Boyd, 2008). With support and encouragement, young children will learn how to articulate and extend these emerging mathematical understandings.

Learning Math through Nature-Focused Activities

In addition to attending to the guidelines described above, teachers would do well to use nature as a resource for reinforcing and extending young children's mathematical understandings and skills. Nature is rich in diversity and offers unending opportunities for manipulating materials and observing many math-related attributes, such as size, quantity, and shape.

Children consider shape and size, for example, as they sort and classify such natural materials as leaves, seeds, and rocks. You can encourage sorting and classifying by providing a variety of natural materials and some sorting containers or trays. For sorting materials, you can provide — or have the children collect — things like leaves of different colors or shapes, different types of blossoms or flowers, and pebbles of different sizes. Egg cartons and other types of

small containers can be used as sorting trays. As children sort the materials, you might invite comments about how the materials differ from each other: how some are bigger than others, how they have different colors, how they feel different, and so on.

As children sort objects into groups, you can also promote ideas relating to quantity. You might ask, for example, "Which group has more?" and "Which group has less?" When focusing on quantity, keep in mind that 'more' in mathematics refers to a greater number as in 'five is more than two.' In everyday usage, however, 'more' can refer to the size of an object, such as a large piece of pie is 'more' than a small piece. Of course, we want children to learn the mathematical understanding of 'more' as well as the informal use of the term. As it relates to quantity, young children can generally identify which of two groups is 'more' or 'less' even before they learn to count. In fact, understanding the mathematical concept of 'more' can help children see the usefulness of counting.

Nature-related activities can also be used to promote mathematical concepts relating to other dimensions of material things. The shape of objects is one dimension you can focus on with preschool-age children. There are shapes all around us in the natural world. Helping children describe these shapes will build their observation skills and vocabularies. Children can describe lines and shapes they see in the natural world by using words like 'round,' 'curved,' 'straight,' 'pointy,' and 'bent.' They also may begin to use vocabulary like 'rectangle,' 'square,' and 'circle.' It's far more interesting to identify geometric shapes in nature than to do so with pictures or cards.

Summary

Young children are naturally curious and eager to learn. Literacy and vocabulary acquisition are vital components of preschool education, and mathematical literacy is an important part of general literacy. Objects from the natural world — like feathers, flowers, leaves, pebbles, and twigs — catch children's attention because of the variety of colors, shapes, and textures they offer. Using objects from the natural world as manipulatives can simultaneously foster an appreciation for nature and begin to build mathematics thinking and vocabulary.

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