

# The Importance of the Early Years

Douglas Clements and Julie Sarama

*Research provides findings—some surprising—about the importance of math for young children. **Douglas Clements** and **Julie Sarama** explore these and suggest ways to build up children’s mathematical concepts and skills.*

Nearly a century ago two giants of psychology gave quite different impressions of the role of math in the lives and education of young children.

It seems probable that little is gained by using any of the child’s time for arithmetic before grade 2, though there are many arithmetic facts that he [sic] can learn in grade 1.

—Edward L Thorndike, 1922

Children have their own preschool arithmetic, which only myopic psychologists could ignore.

—Lev Vygotsky, 1935

Throughout history, views of the role mathematics should play in young children’s lives have differed widely. However, recent research has revealed striking findings of its importance and role in education.

## Young Children Need to Learn Math

The early years are an especially important period for learning math. Children’s knowledge of math in the preschool and early elementary years predicts their mathematics achievement for years later—throughout their school career. Moreover, what they know in math also predicts their reading achievement later. Their early knowledge of literacy also predicts their later reading ability—but only reading ability. Given that early math predicts later math *and* reading, it appears that math is a core component of cognition. Learning math is therefore important. This is especially true for children from deprived communities, who often have not been provided with rich opportunities to build math ideas and skills.

## Young Children Can Learn Challenging Math

Even infants can discriminate between groups of two objects and only one object. There is no age too young for mathematical thought. Older children often know more than curriculum developers or teachers believe. Even among those who have not had many advantages, most children starting school can count, recognize some shapes, make patterns, and use nonstandard units of measurement.

Young children often know, and can definitely learn, far more challenging and interesting mathematics than they are taught in most classrooms. Preschoolers often see little or no math, and students in the early years of elementary school engage in math far less than they do in literacy. Furthermore, too many curricula and programs for young children “teach” too much of what they already know. There are examples of good practice, but we can and must do better. High-quality early education results in learning benefits throughout elementary school, especially for children from disadvantaged communities.

## Learning Trajectories: The Secret of Success

Educators generally agree that teachers should “start where the child is” and “differentiate teaching.” But how? Research has provided a powerful tool: learning trajectories. Students follow natural developmental paths in learning mathematics. When teachers understand these—and sequence activities based on them—they build learning environments that are developmentally appropriate and effective. Learning trajectories have three parts:

- *Goals: The big ideas.* Goals should include the big ideas of mathematics—clusters of concepts and skills that are mathematically central and coherent, consistent with children’s thinking, and generative of future learning (e.g., counting and how to solve problems using counting).
- *Development progressions: The paths of learning.* The developmental progression is a typical path children follow to achieve their goal. Our learning trajectories

provide simple labels and examples for each level of each developmental progression, and this is shown in Figure 2.1. The first column describes two main levels of thinking in the counting learning trajectory (there are many more before, in between, and after).

- *Instructional tasks: The paths of teaching.* The final part consists of a set of tasks matched to each of the levels of thinking in the developmental progression. These tasks are designed to help children learn the ideas and skills needed to achieve that level of thinking. That is, teachers can use these tasks to promote students' growth from one level to the next. The second column in Figure 2.1 provides example tasks.

## Benefits of Learning Trajectories

Thus, learning trajectories describe the goals of learning, the thinking and learning processes of children at various levels, and the learning activities in which they might engage. Several “gold standard” randomized control trial studies have shown that curricula and professional development based on learning trajectories increase children’s achievement more than those that do not.

A teacher participating in one of these studies observed one student had almost filled her pretend pizzas with toppings in the task she was working on. As she got

**Figure 2.1 Examples of Selected Levels From the Building Blocks Learning Trajectory**

Developmental Progression	Instructional Tasks
<b>Counter (Small Numbers)</b> <ul style="list-style-type: none"> <li>• Accurately counts objects in a line to five and answers the “how many” question with the last number counted. When objects are visible, and especially with small numbers, begins to understand cardinality. “1, 2, 3, 4, . . . 5!”</li> </ul>	<b>Cubes in the Box:</b> A child counts a small set of cubes. Put them in the box and close the lid. Then ask the child how many cubes you are hiding. Tip them out and count together to check.
<b>Counter and Producer (10+)</b> <ul style="list-style-type: none"> <li>• Counts and counts out objects accurately to ten and then beyond. Keeps track of objects that have and have not been counted.</li> <li>• Counts a scattered group of nineteen chips, keeping track by moving each one as they are counted.</li> </ul>	<b>Road Race Counting Game:</b> Students identify number amounts (from one to five) on a dot frame and move forward a corresponding number of spaces on a game board.  <b>Counting Tower:</b> Allow children to count to twenty and beyond. Ask them to make towers with objects such as coins. Children should build a tower as high as they can, placing more coins but not straightening coins already in the tower. The goal is to estimate and then count to find out how many coins are in your tallest tower. To count higher, have children make pattern “walls.” They build a pattern block wall as long as they can. This allows them to count to higher numbers.

ready to roll the number cube, she said, “I’m going to get a high number and win!” “You can’t,” replied her friend, “you have four spaces and the number cube only has ones, twos, and threes on it.” The teacher reported, “The numbers may be small, but the reasoning was impressive!” Such thinking is one reason why math is a core component of cognition.

## What We Know

- Learning math at an early age is critically important for young children, especially those from disadvantaged communities.
- Educators often underestimate what young children know and can learn about mathematics.
- Using research-based learning trajectories is effective in promoting math learning.

## Authors’ Note

This paper was based upon work supported in part by the Institute of Education Sciences (IES) (U.S. Department of Education, under the Interagency Educational Research Initiative (IERI), a collaboration of the IES, National Science Foundation (NSF), and the National Institute of Child Health and Human Development (NICHD) under Grant No. R305K05157, “Scaling Up TRIAD: Teaching Early Mathematics for Understanding with Trajectories and Technologies.”

## About the Authors

**Douglas Clements** is a State University of New York (SUNY) distinguished professor. **Julie Sarama** is associate professor of learning and instruction at the University at Buffalo, SUNY. They conduct research on young children’s learning of math, geometry education, and the scale-up of scientifically based curricula and intervention models.

## References and Further Reading

- Clements, D. H., & Sarama, J. (2009). *Learning and teaching early math: The learning trajectories approach*. New York: Routledge.
- Cross, C. T., Woods, T. A., & Schweingruber, H. (Eds.). (2009). *Mathematics learning in early childhood: Paths toward excellence and equity*. Washington, DC: The National Academies Press.

National Council of Teachers of Mathematics. (2006). *Curriculum focal points for prekindergarten through grade 8 mathematics: A quest for coherence*. Reston, VA: Author.

Sarama, J., & Clements, D. H. (2009). *Early childhood mathematics education research: Learning trajectories for young children*. New York: Routledge.

Copyright Corwin 2014