

Unit 10 Research



Estimation is a pervasive process in the lives of children. “How many steps from the classroom to the cafeteria?” “How long is one minute? Close your eyes and open them when you think one minute is up.” “How many jellybeans are in the jar?” “How many cups of water will it take to fill the bucket?” Without the ability to estimate reasonably accurately, life would be difficult. The most consistent conclusion reached by investigators of the development of estimation is that young children are not very skillful estimators. This conclusion was reached by researchers studying estimations of various properties, including distance, money, number of objects, and answers to math problems.⁽¹⁾ The difficulty young children have with estimation has been ascribed to various causes: mindless symbol manipulation, lack of number sense, and lack of relevant conceptual structures.

Little is known about the ability of children in early childhood to estimate the size of collections. Unlike their sense of small numbers, children’s sense of “large” numbers is not well defined. With small numbers—numbers they can relate to concrete examples and experiences—children have a well-developed sense of number size. For example, one is clearly distinct from, and clearly smaller than, two. With large numbers—numbers that they cannot relate to concrete examples and experiences—children have little or no sense of number size. As a result, they do not clearly distinguish among such numbers and may have great difficulty ordering them.⁽²⁾ Fuson and Hall hypothesized that younger children may have difficulty estimating the size of collections larger than five because they have not constructed numerical benchmarks. In their research, they found that many kindergartners appear to have an over-exaggerated mental image of ten and twenty, and some even had an over-exaggerated view of five.⁽³⁾ Through everyday experiences of counting collections of five, ten, and so forth, children gradually construct mental benchmarks that allow them to better gauge the size of collections of five and larger. Constructing a sense of number size is a

gradual process that comes from using and thinking about numbers in everyday situations. In other words, it comes from relating numbers to personally meaningful experiences.

Research on using a number line from the 0 to 100 range with young children indicates a correlation between number-line estimation and math achievement. In Siegler and Booth’s 2004 research, children were given sheets of paper showing a blank number line with only 0 at one end and 100 at the other end. They were asked to show where they thought different numbers (random numbers such as 17, 52, 6, 81, 96, 12, etc.) would fall on the line by marking the right location with a pencil. Construction of a linear representation of numbers seems crucial to mathematical development.⁽⁴⁾ Reliance on a linear representation with a given number range is related to the ability to learn answers to unfamiliar math problems in that range. Young children whose number-line estimation indicates a linear representation produce errors that are closer to the correct answer. Young children’s estimates become more accurate and linear with age and experience.

Starfall Math instruction is written in harmony with the children’s ways of learning. This requires sensitive observation and thoughtful questions at critical junctures (“How many pages do you think are in this book?” “Are there more boys than girls in our class?” “Which will take more time: walking to the gym or to the library?”) Children’s interests, ideas, and strategies should remain at the center of early childhood mathematics education.⁽⁵⁾ We encourage teachers to foster the development of children’s number sense in everyday situations and where appropriate (when an exact amount is not needed or in situations where only a quick look is possible), by encouraging children to estimate the size of collections. Look for opportunities to have children compare the relative sizes and differences in collections. “Your new neighbors have an eight-year-old boy and a six-year-old girl. Who do you think is older?”

(1) Hecox, E, and Hagen, J. W., (1971) Estimates and Estimate-based Inferences in Young Children, *Journal of Experimental Child Psychology*, 11, 106-123.

(2) Baroody, A. J., with Coslick, R. T. (1998). *Fostering children's mathematical power: An investigative approach to K-8 mathematics instruction*. Mahwah, NJ: Erlbaum.

(3) Fuson, Karen C., and James W. Hall. (1983) "The Acquisition of Early Number Word Meanings: A Conceptual Analysis and Review." In *The Development of Mathematical Thinking*, edited by Herbert P. Ginsburg, pp. 49-107. New York: Academic Press.

(4) Siegler, Robert S. and Booth, Julie L. (2004) "Development of Numerical Estimation in Young Children," *Child Development*, March/April 2004, Volume 75, Number 2, Pages 428 – 444.

(5) Clements, Douglas H. (1999) Playing math with young children. *Curriculum Administrator*, 34(4), 25- 28.

Unit 10 Frequently Asked Questions

Why is teaching estimation in kindergarten important?

For many children, estimation is a difficult concept. Kindergarten children want to be right, so if there are 18 objects, saying there are about 20 is not good enough! Although children are usually encouraged to calculate the correct answer, being able to estimate is a valuable skill. The ability to estimate shows that a child has good number sense. Children who have good number sense are able to use that skill to determine whether their answer to a math question is reasonable.

It is important for children to understand that estimation does not replace the need to produce accurate answers. However, teaching children to estimate helps them become critical thinkers and better understand expectations. Children also learn early on to use mental math in order to arrive at reasonable answers to problems.

In real life, estimation is part of our everyday experience. When shopping in the grocery store and trying to stay within a budget, for example, we estimate the cost of the items we place in our carts to keep a running total in our heads. For young children the ability to estimate helps them to determine how much they might accomplish in a given period of time, for example when the teacher informs children that they have only five more minutes to work or play before clean up time.

How do you prepare children to estimate?

The Common Core Standards require estimation skills at every grade level. In kindergarten, Starfall uses language with children that includes such words and phrases as *about*, *close*, *just about*, *a little more (or less) than*, and *between*. These concepts are introduced and reinforced throughout the Starfall Math Curriculum before the concept of estimation is introduced.

The intention of *Estimate with Backpack Bear*, a book included in the program, is to provide the children with many opportunities to practice their estimation skills in a variety of settings, and reinforce the fact that estimation is making smart guesses to find numbers that are close to the right answers.