Unit 8 Research

Counting is adding. Each counting number adds one more to the previous number. This observation is essential for children's early methods of solving addition problems. Also, each step in the counting process can be thought of as describing the total number of objects that have been counted so far.[1] Children first learn the comparing terms "equal to" and "more than" for two groups of things or two numbers. They find out which one is bigger and which one is smaller or if they are equal by matching and by counting. Addition is used to relate amounts before and after combining, to relate amounts in parts and totals, or to say precisely how two amounts compare. Situations that can be formulated with addition occur in a wide variety of story problems.

Once children recognize that the sum of a given number plus one is simply the number after the given number, they use this knowledge as a scaffold for inventing a counting-on strategy for starting with a cardinal value of a number (e.g., four and three more: four, five is one more, six is two more, seven is three more – so the answer is seven). In other words, given a problem such as "four and three more," children seem to recognize that "four and one more" would be the next number in the number-word sequence (five) and reason that "four and three more", then, must be three numbers past four (five, six, seven).[2] This shortcut allows them to compute sums without having to start their count from one each time.

Math instruction for young children should begin with informal representations of math ideas. Initially, teachers should link math ideas to familiar experiences and terms, resisting the urge to use more formal methods until children have a conceptual foundation for understanding.[3] Once children are comfortable using informal methods and representations to describe math ideas, such as "more" and "all together," teachers can help them link formal math vocabulary, symbols, and procedures to their informal knowledge or experiences. They should explicitly teach children math words so they have the vocabulary needed to connect their informal knowledge to formal terms. Teachers can use this math vocabulary when speaking to children throughout the day, not just during math instruction. Math conversations can happen spontaneously as teachers comment about natural occurrences that involve number or other math concepts. Linking formal representations to informal concepts and representations enables children to understand and more readily learn formal terms, symbols (+ or =), definitions, or procedures.[4]

It is often assumed that solving real-life or story problems is a relatively difficult task and that problem solving should be introduced after formal addition skills (e.g., after they have memorized the basic facts or at least after more concrete experiences). However, children can often solve simple real-life problems before they comprehend formal expressions such as 5 +2 = ?.[5] Research indicates that many children can also use their informal arithmetic knowledge to analyze and solve simple addition word problems before they receive formal arithmetic instruction.

(1) National Research Council. (2009) *Mathematics Learning in Early Childhood: Paths toward Excellence and Equity.* Washington, DC: National Academies Press

(2) Baroody, Arthur J., Jesse L. M. Wilkins, and Seipa Tiilikainen. (1995) "The Development of Children's Understanding of Additive Commutativity. In *The Development of Arithmetic Concepts and Skills: Construction Adaptive Expertise,* Mahwah, NJ: Lawrence Erlbaum Associates

(3) Arnold, D., Fisher, P. H., Doctoroff, G. L., & Dobbs, J. (2002). Accelerating math development in Head Start classrooms. *Journal of Educational Psychology,* 94(4), 762–770.

(4) National Association for the Education of Young Children & National Council of Teachers of Mathematics. (2010). *Early childhood mathematics: Promoting good beginnings.* Retrieved from http://www.naeyc.org/files/naeyc/file/positions/psmath.pdf National Council of Teachers of Mathematics.

(5) Carpenter, Thomas P. "Conceptual Knowledge as a Foundation for Procedural Knowledge: Implication from Research on the Initial Learning of Arithmetic." In *Conceptual Procedural Knowledge: The Case of Mathematics,* edited by Harold L. Schoen and Marilyn J. Zweng. Reston, VA: National Council of Teachers of Mathematics, 1986

Unit 8 Frequently Asked Questions

Why does Starfall introduce addition so early in the curriculum?

Addition is introduced after the children have had the opportunity to develop number sense. To allow for this, the first semester focuses on the prerequisites necessary to successfully perform the operation of addition. These prerequisites, which are then spiraled throughout the Starfall math curriculum include:

- Counting to 20 or beyond
- Recognizing numerals 0 through 9
- Correctly counting a given number of objects
- Understanding the concepts of more than and less than (greater than and less than)
- Counting on from a given number
- Matching a number of objects with the corresponding numeral symbol
- Writing the numerals 0 through 10
- Recognizing coins and their values
- The ability to see patterns
- Subitizing

Teaching addition earlier in the school year rather than later provides more time for the children to practice their skills and helps them master the relationships between numbers and understand how quantities relate to each other.

Why does the Starfall math curriculum focus so much on story problems when so many children seem to struggle with this concept?

Story problems help bring math to life and give numbers a purpose. For these reasons, the Starfall curriculum introduces story problems long before formally introducing the concept of addition.

The keys to understanding and solving story problems are vocabulary and number sense. Early in the school year math terms such as greater than, one more than, altogether, and how much are introduced. However, relying solely on certain key words that signal specific operations is not enough!

Children are also introduced to eight different strategies for solving addition problems. Many of these strategies are then applied to solving addition story problems. Providing these strategies helps children visualize a problem.

Children need repeated practice applying math concepts to solve real life problems. Providing real-life situations that children can relate to, inserting their names into the story problems, and then moving on to more difficult components such as adding numbers to problems that do not affect the outcome, can lead to future success.