Unit 6 Research

Shape is a fundamental idea in mathematics and in early childhood development. Beyond mathematics, shape is the basic way children learn the names of objects, and attending to the objects' shapes facilitates that learning.[1] Through the study of geometric shapes, children can begin to develop ways to mentally structure the spaces and objects around them and develop mathematical reasoning ability. Every 2-D shape or 3-D object has multiple aspects: the overall shape, the particular parts and features of the object or shape, and the relationships among these parts and the whole object or shape. Young children need time to observe and analyze the parts and features of geometric shapes, the "inside region" and the "outer boundary," the number and length of sides, and the nature of these sides and their relationships to each other. The study of geometric shapes is not only about seeing shapes as wholes, it's about finding and analyzing their properties and features.[2]

Children first identify shapes at the visual level on the basis of their appearance, then represent shapes at the "descriptive" level on the basis of their properties. They tend to regard squares as a distinct category and not as a special kind of rectangle with four sides that are equal in length. Children should learn that a square is a special type of rectangle (a square-rectangle). This approach has been shown to be successful with kindergartners.[3]

Children need to experience various examples of shapes and understand their attributes. Examples of triangles and rectangles should include a wide variety of shapes, including "long," "skinny," and "fat" examples.[4] As children move beyond perceiving and naming shapes, they build mathematical concepts as they discuss the parts and attributes of shapes. Well-designed activities using hands-on manipulatives can effectively build geometric and special skills and general reasoning abilities. Extensive mathematics research conducted by Douglas H. Clements, a leading teacher, researcher, and writer in early childhood mathematics at the State University of New York at Buffalo, has shown that the use of manipulatives helps young children develop geometric and spatial thinking. Manipulatives, either physical or using a computer, assist children in constructing mathematical meaning. Computers can be used to carry out mathematical processes that are difficult or impossible to perform with physical manipulatives.[5] In a Starfall Math classroom, children build squares and other polygons with toothpicks and marshmallows; they form shapes with play dough or with their bodies, either singly or with their classmates. They gather rectangles and describe in their own words why their shapes are rectangles. Children are shown a variety of shapes and have to decide whether they are or are not rectangles and why. Children work online at Starfall.com on the Geometry and Measurement section of the Math Index.

In summary, key findings from broad research in mathematics in early childhood education tells us that children are better prepared for all school tasks when they gain the thinking tools and representational competence of geometric and spatial sense.[6]

(1) Jones, SS., and Smith, L.B. (2002). How children know the relevant properties for generalizing object names. *Developmental Science,* 2, 210-232.

(2) Committee on Early Childhood Mathematics, (2009). *Mathematics Learning in Early Childhood: Paths toward Excellence and Equity.* Cross, C.T., Woods, T. A., and Schweingruber, H. (Eds). Washington, D.C.: National Academies Press.

(3) Clements, D.H., and Sarama, J. (2007). Early childhood mathematics learning. In F.K. Lester, Jr. (ed.), *Second Handbook of Research on Mathematics Teaching and Learning* (pp. 461-555). New York: Information Age.

(4) Seo, K.H., and Ginsburg, H.P. (2004). What is developmentally appropriate in early childhood mathematics education? In Clements, D.H., Sarama, J., and DiBaise, A.M. (Eds.), *Engaging Young Children in Mathematics: Standards for Early Childhood Mathematics Education* (pp. 91-104). Mahwah, NJ: Erlbaum.

(5) Clements, D. H. (1999). Concrete manipulatives, concrete ideas. *Contemporary Issues in Early Childhood*, 1 (2, 45-60).

(6) Ginsburg, H.P., Greenes, C., and Balfanz, R. (2003). *Big Math for Little Kids.* Parsippany, NJ: Dale Seymour.

Unit 6 Frequently Asked Questions

Why does the Starfall Math curriculum spend so much time teaching shapes?

Most children have many ideas about shapes upon entering kindergarten. However, teachers often do not question children appropriately in order to extend their ideas. Many times the questions teachers ask are closed-ended and require simple recall to answer correctly.

Research shows that young children's concepts about shapes stabilize by six years of age, but that these concepts are not necessarily accurate. Starfall Kindergarten Math builds on children's prior knowledge and generates new content. The children learn and practice awareness of shape properties, identify individual shapes in a variety of positions, and experiment with combining smaller shapes to create larger ones. Children are asked to complete statements such as "I know this is a (name of shape), because (shape's properties)." Doing so provides them the opportunity to identify shapes using their attributes or properties. Learning the accurate properties of two-dimensional shapes lays the foundation for future understanding of three-dimensional shapes.

Starfall Kindergarten Math introduces math nets. Isn't working with math nets a 5th-grade skill?

A math net is simply a two-dimensional paper shape that can be folded to create a three-dimensional shape. When a math net is laid flat, it shows the pattern of a three-dimensional shape, including each of its faces. By introducing math nets in kindergarten, the children see more concretely the relationship between two-dimensional and three-dimensional shapes.

Spatial thinking plays a fundamental role in our lives, ranging from the everyday activities we take for granted (e.g., navigating a new city, assembling furniture, remembering the location of objects, etc.) to the more specialized skills required for higher education and various professions (e.g., architecture, dentistry, medicine, art and design). Recent research shows that spatial thinking is strongly related to entrance and success in science, technology, engineering, and math (STEM) disciplines.

Learning two-dimensional shapes is key for further math learning. If children don't recognize two-dimensional shapes, they most likely will not be able to recognize three-dimensional shapes. Using math nets is a way to help the children see the relationship between them.