Measurement and Geometry: Building Conceptual Understanding in Young Children

Video Note Taking Guide

Presenter: Cindy Stone

Goals of Today's Session

- Understand what the research says
- Understand the big mathematical ideas in the activities and why we teach what we teach
- Form a network of colleagues and a support system to continue growth in mathematical content knowledge

Research

- Students need to "mentally structure and revise their construction of space…." National Research Council, 2001
- We are not doing an adequate job of teaching measurement; perimeter, area and volume, and geometry. Schmidt, Houang, & Cogan, 2002
- As students study increasingly sophisticated mathematics and science, those who are able to construct and analyze physical and mental models will be at an advantage. Consider the use of spatial reasoning in the fields of computer networking, communications technology, architecture, and the development of CAD. Mokros, Russell & Economopoulos, 1995

Research

- **Modeling, generalization, and justification are not learned in the abstract…these practices are embedded in the process of learning important mathematics and science ideas.** Carpenter & Romberg, 2004
- **Approaching mathematics content through investigations helps students develop flexibility and confidence in approaching problems, fluency in using mathematical skills and tools, and proficiency in evaluating their solutions.** Kliman & Russell, 1998

Assessment – Not a Snapshot, a Photo Album

- **All concepts develop over time; assessment should show development from naïve to sophisticated understanding**
- **How will I know when my students know what I want them to know?**
- **What will constitute acceptable evidence?**
- **How can I grade a hands-on task?**
- **Multiple tasks for assessment – the key word is BALANCE**
  - Concrete
  - Semi-concrete
  - Abstract

Rubrics

A rubric is a scoring guide for assessing student work

The rubric describes the criteria for each performance level

Rubrics are measuring tools that are usually tailor-made by the person doing the assessing

Rubrics can be either holistic or analytic in nature

The *holistic* rubric focuses on the entire response; the assessor evaluates the work as a whole

The *analytic* rubric is more like a checklist and looks at specific aspects of the response

Mathematical Tasks

- **Tasks should connect to prior lessons and real world contexts**
- **Tasks should be open enough to provide a challenge to gifted children while allowing for success for at-risk students**
- **Tasks should be based on standards, not what the teacher likes to teach**

Questioning in the Mathematics Classroom

- **Teacher questioning:**
  - Can you draw, explain, or write about your thinking and your solution?
  - Will your solution always work?
  - Will your solution work only in some circumstances?
- **Student questioning:**
  - Students should be taught to question each other
  - Students should be provided opportunities to say they don't understand or to ask for clarification

What's in a Bucket?

- **Task 1:**
  - Use pieces of yarn or any other tool in the bucket to measure the height, diameter, and circumference of the bucket
  - Record your results
- **Task 2**
  - Use index cards, Post-it® notes, or paper to cover the outside surface of the bucket
  - Record your results

What's in a Bucket?

- **Task 3**
  - Hang the bucket from the spring scale. Fill the bucket with 10 items, 20 items, 30 items, and on up to 100 at 10-item increments. Record the weight at each interval. Discuss and record your results
- **Task 4**
  - Fill the bucket with water, sand , or rice. How many cups did it hold?
  - Record your results

What's in a Bucket?

- **Class Discussion**
  - Were the measurements the same?
  - Why or why not? Explain your thinking in your Mathematics Journal.
  - At what age would these activities be appropriate? Why non-standard units of measure?
  - What standards do they address?
  - What are the mathematical concepts these activities are developing?

Quick Images (from Investigations in Number, Data, Space)

- **Task 1**
  - You will be shown a geometric shape on the overhead for a few seconds. You will then draw the shape on your paper.
  - These shapes will use 3 – 10 dots in various formations.
- **Task 2**
  - You will be shown a geometric shape on the overhead again and this time try to replicate it with interlocking cubes.

Class Discussion

- What concept do these two activities develop?
- Why do we ask students to share what they saw? Didn't they all see the same thing?
- How could this be expanded upon as students master these activities?

What Were the Mathematical Concepts?

- Spatial reasoning
- Relationships between units of measure and length, diameter, circumference of a container, surface area, and volume

State Standards Addressed

- Kinder
  - Spatial reasoning
  - Objects are alike and different
  - Describe and identify an object by its attributes using informal language
  - Compare two objects based on their attributes
  - Describe and compare real-life objects or models of solids
  - (10) Measurement. Compare and order two or three concrete objects according to length (shorter or longer), capacity (holds more or holds less), or weight (lighter or heavier)

State Standards (cont.)

- 1st grade
  - Geometry and spatial reasoning
  - Describe and identify objects in order to sort them according to a given attribute using informal language
  - Estimate and measure length, capacity, and weight of objects using nonstandard units

State Standards (cont.)

- 2nd grade
  - Geometry and spatial reasoning
  - Identify attributes of any shape or solid
  - The student recognizes and uses models that approximate standard units (metric and customary) of length, weight, and capacity

References

- Carpenter, Thomas, & Romberg, Thomas, (2004). *Powerful Practices.* University of Wisconsin. Madison.
- Kliman, Marlene, and Russell, Susan Jo, (1998). *Building Number Sense.* TERC. Cambridge.
- Mokros, Jan, Russell, Susan Jo, & Economopoulos, (1995). *Beyond Arithmetic*. Dale Seymour. Palo Alto.
- National Research Council, (2001). *Adding It Up.* National Academy Press. Washington, D.C.
- Schmidt, William, Houang, Richard, and Cogan, Leland, (2002). *A Coherent Curriculum: The Case of Mathematics*. Research for Better Schools. Philadelphia.