Measurement and Geometry: Building Conceptual Understanding in Young Children

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No Child LEFT BEHIND

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
- 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

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 and 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 and 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 the different pieces of yarn to measure the height, diameter, and circumference of the bucket.
  - Record your results.
- **Task 2**
  - Use the index cards 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. 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

- **Students use informal language and observation of geometric properties to describe shapes, solids, and locations in the physical world and begin to develop measurement concepts as they identify and compare attributes of objects and situations. Students collect, organize, and display data and use information from graphs to answer questions, make summary statements, and make informal predictions based on their experiences.**
- **Kinder**
  - (8) Geometry and **spatial reasoning**. The student uses attributes to determine how **objects are alike and different**. The student is expected to:(A) **describe and identify an object by its attributes** using informal language;(B) **compare two objects** based on their attributes
  - (9) Geometry and spatial reasoning. The student recognizes characteristics of shapes and solids. The student is expected to:(A) **describe and compare real-life objects or models of solids**
  - (10) Measurement. The student uses attributes such as length, weight, or capacity to compare and order objects. The student is expected to:(A) **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);** and(B) find concrete objects that are about the same as, less than, or greater than a given object according to length, capacity, or weight.

State Standards (cont.)

- **1st grade**
  - (6) Geometry and spatial reasoning. The student uses attributes to identify, compare, and contrast shapes and solids. The student is expected to:(A) **describe and identify objects in order to sort them according to a given attribute using informal language;** (C) combine geometric shapes to make new geometric shapes using concrete models.
  - (7) Measurement. The student uses nonstandard units to describe length, weight, and capacity. The student is expected to:(**A) estimate and measure length, capacity, and weight of objects using nonstandard units;** and(B) describe the relationship between the size of the unit and the number of units needed in a measurement.

State Standards (cont.)

- **2nd grade**
  - (7) Geometry and spatial reasoning. The student uses attributes to identify, compare, and contrast shapes and solids. The student is expected to:
  - (A) **identify attributes of any shape or solid**;
  - (9) Measurement. The student recognizes and **uses models that approximate standard units (metric and customary) of length, weight, capacity**, and time. The student is expected to:
  - (A) identify concrete models that approximate standard units of length, capacity, and weight;(B) measure length, capacity, and weight using concrete models that approximate standard units

Fall Follow-up

- I will post lessons. As a group, we will discuss ways to strengthen geometry and measurement connections.
- You will find one lesson, identify the core math that is being taught, what misconceptions students might have, and how to address those misconceptions.
- We will post these, according to topic, and discuss our experiences.

References

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