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Taking a Closer Look at Measurement – Using Teacher Read Alouds of Nonfiction to Develop Students' Measurement Sense

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Many students think of measurement as a set of procedures, for example, lining up a ruler with an object, and stating the number on the ruler that corresponds with one end of the object. This may be one reason that measurement is typically one of the weakest areas of mathematical achievement on the National Assessment of Educational Progress (Struchens, Martin, & Kenney, 2003). To combat students' weaknesses in measurement, we suggest that in the early grades they need to develop a feel for standard measurement units, such as inches and feet, and become familiar with real world referents that correspond to those units in magnitude (Joram, 2003; Joram, Gabriele, Gelman & Subrhamanyam, 2005). Hope (1989) notes that developing knowledge of a wide variety of everyday referents for measurements (e.g., doorways are about 2 meters in height) is foundational to number sense in the arena of measurement, or *measurement sense*.

Mathematics educators and teachers have used a variety of strategies in the early elementary grades to help students develop measurement sense, such as comparing and ordering objects on the basis of an attribute such as weight, working with nonstandard units, engaging in measurement estimation, etc. (Dacey, Cavanagh, Findell, Greenes, Sheffield, & Small, 2003). Reading children's literature aloud to students and providing corresponding exercises has also been discussed as a way to build children's understanding of measurement concepts (e.g., Lubinski & Thiessen, 1996; Thiessen, Matthias, & Smith, 1998). We wedded two of these popular instructional strategies, and read nonfiction texts aloud to first-grade students while asking them to engage in a variety of measurement estimation activities.

Bright (1976) notes that, although measurement estimation is most often thought of as providing a measurement when shown an object (e.g., "How many inches long is this pencil?," yielding the answer "6 inches long"), children need practice going in the other direction, that is, from a measurement to a

magnitude. He suggests that teachers ask students, for example, to find objects in the room that are 6 inches in length. Working in both directions, from object to measurement and from measurement to object, will help students develop visual images of the magnitudes corresponding to measurements – an integral aspect of measurement sense (Joram, 2003). To accomplish this goal, students can engage in a variety of activities that include finding objects, drawing lines, or showing magnitudes of specified sizes with their hands or other body parts. We integrated these kinds of activities into teacher read alouds of several nonfiction books from the *Look Closer* series.

In the new edition of the *Look Closer* series, each page contains colorful images of animals coupled with information that is likely to be of high interest to students, for example, that owls eat their prey whole and later cough up the bones, feathers and fur in a lump called a pellet (Malyan, 2005). Size information is provided about each animal, as in the following statement: "Green woodpeckers are 12 in (31 cm) long and can live up to 15 years." We focused on these kinds of measurements in our lessons, and designed several extension exercises to go along with them.

We taught the lessons near the end of the spring semester, after students had worked on measurement for several weeks and had been introduced to standard measurement units. Students both estimated and checked the accuracy of their estimates with rulers because we thought it likely that going back and forth this way would help them see the relationship between estimated units and units represented on standard instruments.

Looking Closer at Measurement – Description of the Lessons.

Faith began the first lesson by reading aloud to the students the pages describing oystercatchers from *Look Closer: Birds* (see Figure 1), including the statement "Oystercatchers can grow to 18 in (45 cm) long" (Malyan, 2005, p. 14).

Figure 1

She then asked the students to show 18 inches with their hands. Mallory and Neriah showed their estimate of 18 inches, by holding up their hands (Figure 2). Faith then challenged the class to figure out how to check the accuracy of these estimates. Hannah reminded the class that rulers are 12 inches long, and Faith then passed out rulers and pairs of students tried to figure out what a magnitude of 18 inches might look like.

Figure 2

Caleb and Hannah figured out together that if they superimposed one ruler over the other, and had only six inches showing of the second ruler, their two rulers together would measure 18 inches (see Figure 3). It is interesting to see how Hannah then used her hands to show the entire extent of the 18 inches, spanning one whole ruler and half of the other. Having students show measurements with their hands, a kinesthetic representation of magnitude, is likely to foster number sense about measurements.

Figure 3

Further, wrestling with a difficult problem like figuring out how to show 18 inches with 12 inch rulers pushed students beyond a procedural view of measurement (reading a number from the end of the ruler) to focusing on counting units to measure.

In the next extension exercise, Faith chose a segment of *Look Closer: Birds* that dealt with the rate of growth of one type of bird. She read aloud a statement about a partridge that illustrates the use of measurements to show growth: "A red-legged partridge chick stands 3 in (8 cm) high. An adult grows to 14 in (34 cm) (p. 12)." Faith asked students to estimate the length of 3 inches by first showing it with their hands and having their partner check the accuracy of the measurement. She next asked students to show the growth of the chick, going from 3 inches to 14 inches in height, by moving their hands. Creating this kind of dynamic representation of increasing size may add to students' sense of measurement in the context of growth and change. Later, teachers can build on this to develop an understanding of how two variables, for example, height and age, are related (e.g., Joram & Hartman, 2004).

Faith wanted to expose her students to experiences with larger measurements, and so during a second lesson, she read from *Look Closer: Reptiles* (Malyan, 2005). The book stated that mangrove snakes can

grow to be 8 feet long (2.5 meters), and Faith asked students how they could show 8 feet. Tristan came up with the idea of laying out paperclips on the floor in a line, showing his use of nonstandard measurement units to represent measurements. Faith acknowledged that Tristan's method would yield a correct answer, but asked the students to try to figure out a way of showing the measurement that would not take as much time. In doing so, she pushed them to identify appropriate units of measure, which is a targeted measurement concept in first grade mathematics.

Because the students had been recently measured in their classrooms, it was fresh in their minds that many of them were about four feet tall. Before we knew it, several students had laid down, head to toe, to show that two students laying on the floor would make up 8 feet, the length of the mangrove. This was a creative and reasonable use of nonstandard units – their bodies – to show the magnitude of 8 feet.

Large magnitudes can also be found in the book *Prehistoric Actual Size* (Jenkins, 2005). Jenkins provides measurements of prehistoric animals in both customary and metric units. An activity to go along with a read aloud of this book might include asking students to show the length of "Giganotosaurus," which was 45 feet, or 14 meters, long, by laying down masking tape on the hallway floor.

Conclusions

Using nonfiction to teach measurement, as described above, has a number of strengths. First, rather than teaching measurement concepts in a matter of two or three weeks, as is often the case, using nonfiction books to teach measurement concepts provides a way to distribute the teaching of measurement throughout the year. Although these lessons were taught near the end of the year, nonfiction books such as the *Look Closer* series could also provide a means for first introducing measurement concepts, including metric measurement units.

Second, books like the *Look Closer* series or *Prehistoric Actual Size* allow teachers to integrate mathematics and science content areas. District benchmarks for science for Faith's class include "Plants and Animals," which entails "Habitats," "Living and Non-living Organisms," and "Lifecycles." With many

teachers today scrambling to meet their district's goals, integrating the teaching of two different subject areas will be a welcome solution to the problem of insufficient time for coverage. This also applies to the integration of mathematics and language arts, afforded by the activities described above. With the emphasis currently placed on introducing nonfiction texts to early elementary level students, books like the *Look Closer* series provide a way to do this while also integrating mathematics and science concepts.

The most important benefit of using nonfiction books to teach measurement is that it will help students to connect measurement concepts to contexts outside of their classroom; in this case, to animals. Books like the *Look Closer* series and *Prehistoric Actual Size* provide a large range of magnitudes for students to model, taking them beyond the kinds of objects and restricted range of magnitude typically found in many mathematics textbooks. Although the examples above pertain to linear measurement, books like *Measuring Penny* (1997), which focuses on measuring multiple attributes of a dog, can be used as well to develop students' measurement sense in the context of other attributes such as weight and capacity.

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