

## President's Message

# Representation—Show Me the Math!

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*Representation* is NCTM's Professional Development Focus of the Year (FOY) for 2006–2007. The theme we will use to promote this FOY is “Show Me the Math: Learning through Representation.” Movie buffs will notice a play on the phrase “Show me the money,” which was popularized by the film *Jerry Maguire*. We chose this phrase because it says exactly what representation does—it shows mathematics to students who are trying to learn and to teachers who are looking for signs that students are understanding what is being taught.

The process of representation includes using models to organize, record, and communicate mathematical ideas, as well as selecting, applying, and translating these models to solve problems and interpret mathematics. The models can be used to “show” math, through the use of manipulative materials, diagrams, graphical displays, and symbolic expressions. Representation also includes internalizing or taking in mathematical ideas and understanding them. Let's think about it from the perspective of the classroom.

**Representation and Planning.** Representation should be an important element of lesson planning. Teachers must ask themselves, “What models or materials (representations) will help convey the mathematical focus of today's lesson?”

When planning a lesson that involves place value and three-digit numbers, an elementary school teacher might consider the use of place value or base-ten blocks (or computer versions of these materials\*). A place-value chart could also be used by students or the teacher to demonstrate that a number, such as 137, can be represented as 1 hundred, 3 tens, and 7 ones, or as 1 hundred, 2 tens, and 17 ones, or in other groupings. A 200-chart could also be used to show that 137 is closer to 150 than it is to 100 or 200.

**Representation and Teaching.** What is the instructional role of representation? Will particular models and materials always work? How do we know they work? How should they be used? What do students learn from their use, and how will this be communicated? These questions related to teaching and learning help teachers think about what students might “see” in a drawing that they create and provide a glimpse of the internal representations students create as they interact with any representation.

Representation can be used by teachers to instruct and by students to solve problems and communicate their mathematical ideas to others. When planning instruction, practice, or reinforcement activities, teachers should consider how they and their students can use representation in today's mathematics lesson.

For example, students and teachers may consider using region, set, or number line representations for comparing  $\frac{4}{5}$ ,  $\frac{6}{8}$ ,  $\frac{8}{10}$ , and  $\frac{1}{2}$ . What if they decide to use the number line for this lesson? This representation may be fairly easy for many

students to create and use, and it allows them to interpret whole numbers, negative numbers, and fractions, decimals, and related percents. Should the students create their own number lines for this lesson? Should software be used? Should the students' number lines be organized by tenths? Should the students determine the intervals on the number line? Should the students be able to use the fractions above to compare equivalent decimals and percents? Notice the attention to the representation and how it may be used.

**Representation and Assessment.** As teachers present lessons, they can use representation to assess and improve students' performance and to make decisions about future instruction. The observations they make, the questions they ask students, and the instructional activities they provide all have potential as formative assessments. They give teachers a glimpse into what students have, or have not, understood. Questions that may help improve performance and guide instruction are:

- How are students using representation to model and interpret the mathematics being presented?
- What do the representations that a student is using tell about that student's understanding of the mathematics?
- What do students provide when asked to use diagrams, sketches, or equations to explain their solution to a problem or task?

As we all recognize the importance of representation, we also need to realize that there is much more to representation than plopping manipulative materials in front of students and directing the modeling of a particular problem. Interviews with students often confirm that some students understand concepts presented with one type of representation but are unable to comprehend the same concept presented with another type of representation (e.g., a student may be able to use fractional cutouts to show that  $\frac{5}{8} + \frac{1}{4}$  is equal to  $\frac{7}{8}$  but will give  $\frac{6}{12}$  as the sum when encountering the equation symbolically). In short, we cannot always rely on particular models or responses to a particular model. We must deliberately plan the use of representation in lessons and continually assess whether or not students are “seeing” and learning mathematics.

So, show your students the math! Consistently provide opportunities for representation and encourage them to use it regularly to record and communicate the mathematical ideas that they are learning.

\* NCTM's *Illuminations* Web site recommends a computer version of base-ten blocks that can be accessed free of charge, by visiting [illuminations.nctm.org/WebResourceReview.aspx?ID=131](http://illuminations.nctm.org/WebResourceReview.aspx?ID=131).