

# Teaching Beliefs

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First, I believe that *learning mathematics* means making sense of mathematical relationships. There are no shortcuts here; no one can do this for another person. Some conventions must be committed to memory and some procedures followed, but everyone must make sense of the relationships for herself. Learning mathematics also means getting better at the action verbs that are often used to describe the thinking habits mathematicians routinely employ: *looking* for patterns, *conjecturing*, *justifying*, *analyzing*, *wondering*, and so on. Everyone can learn these ways of thinking if given the opportunity.

Second, I believe that *teaching mathematics* means helping all students learn to think mathematically. This means setting up situations that give every student the opportunity to engage in sense making. It requires a lot of listening and questioning. It also means explicitly helping students develop attitudes about the nature of mathematics and what is required in its learning. The following paragraphs contain messages that I believe students need to hear and see in action every day.

- Mathematics includes arithmetic, but it is more than just arithmetic. Many middle school students have spent years practicing arithmetic algorithms and evaluating algebraic expressions but very little time engaging in the study of geometry, or probability, or data analysis, or functions. Middle school students also need to be constantly reminded that mathematical thinking is mathematics too.
- There is no direct route to understanding. Mistakes and confusion are an essential part of this process. One of the principles that consistently guides me is this: “We must recognize that partially grasped ideas and periods of confusion are a natural part of the process of developing understanding” (California State Department of Education 1987, 14).
- There are many ways to be good at math. Being fast and accurate with procedures is one way, but other ways include being good wonderers, good visualizers, good explainers, flexible problem solvers, adept pattern finders, or facile technology users. Everyone can be good at mathematics and we need people who are good at all of those different ways in our mathematical community.

- There are many ways to approach most mathematical problems, even those with only one answer. And while some ways may appear to be more efficient than others, what is most important is that everyone has at least one way to solve a problem that she or he really understands. Mathematics should make sense.
- We can get better at the skills of mathematics through practice, but talking and listening to each other (not just the teacher) about mathematical ideas help us understand mathematical ideas in different ways. We really understand what we can explain.

—Cathy Humphreys, writing in *Connecting Mathematical Ideas*, by Jo Boaler and Cathy Humphreys, Heinemann, 2005, pp. 11–12.