MESSAGE

22 We Don't Care About the Answer

YES, WE DO. LOOKING FOR BALANCE

> If I do a good job developing a question, my students and I take a little longer to reach it but we reach it with a greater ability to answer it and more interest in that answer.
>
> —Dan Meyer, mathematics teacher

One summer afternoon I came across a local television news story discussing an innovative summer math program in the school district where I live. I was pleased that a story on math would be on television, and I watched with interest as the interviewer spoke with the program's director. Based on the brief interview, it seemed to me that the program might be helpful for teaching students problem solving. Then the director made a statement that made me want to crawl under a table. I even uttered, "*Nooo!*" as I heard the director say, "We don't even care if students get the right answer. What we care about is how they approach the problem."

I understand what this educator meant. She meant that the *process* a student uses is as important as the answer a student gives. She meant that students could learn something from solving a problem, even if they initially stumble or come up with the wrong answer. She meant that mathematical processes are part of a student's developing set of mathematical tools.

But as mathematics educators, we must also care about whether students get a correct answer. In today's era of higher standards and expectations, the notion that educators might not care about the answer is both false and dangerous. If parents or businesspeople think that mathematics teachers don't care about answers, they will appropriately become concerned about what is going on in school. After all, if students are not arriving at correct answers, or worse, if teachers don't care whether students' answers to mathematics problems are right or wrong, most people would agree that something isn't working.

Caring About the Process

The educator in the interview above was correct in her zeal to care about the process students use to solve a problem. She was reacting to the reality that some teachers don't care what process a student uses to arrive at an answer, as long as the answer is correct. Equally troublesome, some teachers prescribe only one method for arriving at an answer, leaving students who find a novel approach out of luck. Both of these philosophies deny students a critical element of their mathematical learning—developing efficient strategies for solving new problems.

The National Council of Teachers of Mathematics (NCTM) has called for a strong commitment to problem solving and mathematical processes like thinking, reasoning, and making connections (2000), and that commitment is echoed in the Standards for Mathematical Practice that are central to the Common Core State Standards for Mathematics (2014). This focus on mathematical habits of mind is reflected in the kind of program the director was describing in the television interview. Specifically, students can benefit greatly from an opportunity to learn versatile and transferable processes for tackling complex problems. This means doing more than giving students word problems that call for them to use a procedure they just learned. Students need tasks that challenge them to have to figure out what operation(s) might be helpful and how they might connect different mathematical ideas, even if it means exploring a path or two that don't lead immediately to a solution. This is how mathematicians approach problems and it is an increasingly prevalent approach in the workplace. According to Thomas Friedman in *The World Is Flat* (2007), the twenty-first–century workplace demands workers with deep, transferable problem-solving and thinking skills. Friedman emphasizes that workers will need to be able to *versatilize*—transfer skills, generalize what has already been learned, and continue learning new skills for a job that might not have existed last year. Today's need for this kind of transferable critical thinking and complex problem solving is echoed by various business and policy groups such as the National Center on Education and the Economy and the Partnership for 21st Century Skills.

In order for students to learn problem solving well, instruction should start with rich problems calling for more than superficial application of procedures. Students need to work on the kinds of tasks that require them to put together more than one piece of mathematical knowledge, skill, or concept. Teachers need to ask questions that push students' thinking, not replace it. Questions like "If we multiply the answer by three, what do we have?" don't help students with this type of thinking. Instead, teachers can generate greater levels of student thinking by asking questions like: "Why do you think that's true?" "How might your thinking change if the numbers are larger?" Over time, students learn to both ask these kinds of probing questions of each other and also respond to questions that contribute to learning, whether other students or the teacher poses these questions.

Careful scaffolding with probing questions can help students address problems that may initially seem out of reach. But scaffolding loses its effectiveness if we tell students everything they need to know in advance of working on the problem; this takes all the challenge away. Effective scaffolding questions can help students develop increasing levels of independence and willingness to try harder problems than they might otherwise take on. But if overdone, questions intended to provide scaffolding actually can cut student thinking short. Ideally, we want to allow students thinking time by postponing the race to an answer.

Caring About the Answer

Regardless of the care we take to ensure that students learn to think on their own and develop sound approaches to solving problems, we cannot overlook the value of arriving at an answer that makes sense. It may not always be one answer; for some problems, one answer is sufficient, but for other problems, many possible answers can make sense. Regardless, students should be able to justify their answer and explain how they arrived at it. This kind of justification and explanation is a powerful part of learning and should not be overlooked. As a student talks through an explanation, he might recognize and even correct an error he made. And if the approach works, the student, simply by going through the steps again out loud, reinforces the strategy used. This reinforcement increases the likelihood that the student will be able to use the strategy (or one like it) for an appropriate problem in the future. In either case, explaining and justifying answers benefits the learning process, especially when guided by a teacher who is careful not to provide excessive direction. Equally important as the process, therefore, is a student's ability to eventually arrive at an answer and verify that the answer makes sense while addressing all the necessary criteria in the original problem.

What Can We Do?

How we communicate what we do and why we do it is just as important as actually doing the right thing. One appropriate response the educator in the television interview might have offered is "We're teaching students that coming up with a way to solve a problem is just as important as coming up with a correct answer. We want our students to be such strong problem solvers that they can address all kinds of problems they will see outside of school, including those for which we don't know the answer in advance. We also want them to be able to justify the answer they find and verify that it makes sense for the problem." We care about the process a student uses. And we *do* care about the answer.

Reflection and Discussion

FOR TEACHERS

- What issues or challenges does this message raise for you? In what ways do you agree with or disagree with the main points of the message?
- How can you help your students develop effective problem-solving approaches that value both the process and the answer?
- How can you demonstrate to students the value of an incorrect answer as part of a learning process that eventually can lead to a correct answer?
- How can you communicate to the community the value of learning a process even when a student arrives at an incorrect answer?

FOR FAMILIES

- What questions or issues does this message raise for you to discuss with your son or daughter, the teacher, or school leaders?
- How can you support your daughter's or son's learning in ways that value both the process used to solve a problem and also the answer?

FOR LEADERS AND POLICY MAKERS

- How does this message reinforce or challenge policies and decisions you have made or are considering?
- How do you support teachers in helping students learn mathematical processes as well as arrive at answers?
- How can you communicate to the public the importance of mathematical processes as well as the value of arriving at a correct answer?

RELATED MESSAGES

Faster Isn't Smarter

- Message 14, "Balance Is Basic," considers the need for a program to include conceptual understanding, computational skills, and problem solving as well as mathematical thinking and reasoning.
- Message 16, "Hard Arithmetic Isn't Deep Mathematics," looks at the need for depth as well as breadth of mathematics.
- Message 36, "I Know What an 82 Means!" considers the challenges of comprehensively evaluating students' work, including considering the process used and the answer to a problem.

Smarter Than We Think

- Message 18, "Finishing Teaching," reminds us that students may need more time than planned in order to get to the deep understanding we want on priority topics and skills, sometimes calling for us to postpone answer getting.
- Message 8, "Oops!," presents thoughts about the value of mistakes as a critical element within a growth model of intelligence.
- Message 32, "Problems Worth Solving—And Students Who Can Solve Them," looks at the nature of problems that help students develop thinking skills on their way to answers.
- Message 37, "Communicating Mathematically—Using Precision in Language and More," considers the importance of precision in mathematics and reminds us of the need to balance the quest for precision with the importance of student discourse around answers and mistakes students generate when engaged in solving challenging problems.
- Message 31, "Developing Mathematical Habits of Mind," discusses the importance of mathematical processes, practices, and thinking skills as students solve problems.
- Message 45, "Math is *Supposed* to Make Sense," reinforces the notion that sense making should be central to mathematics as students work toward answers.

MORE TO CONSIDER

- *What's Math Got to Do with It?* (Boaler 2008b) looks at important shifts in teaching and learning mathematics for a broad audience of educators and noneducators.
- *Mindset: The New Psychology of Success* (Dweck 2006) provides insights into the nature of intelligence and the role of mistakes in growing minds.

- "The Power of a Good Mistake" (Gojak 2013b) offers a teacher's perspective on the importance of mistakes and how we handle them.
- "The Mathematics Education of Students in Japan: A Comparison with United States Mathematics Programs" (Mastrull 2002) is a personal report that considers various factors in Japanese and American mathematics classrooms, including the notion of postponing answer getting to focus on mathematical learning.
- "From the Inside Out" (Fillingim and Barlow 2010) describes the kind of mathematical thinking involved in helping children move beyond answers to become "doers of mathematics" in and outside of school.
- "What Is Mathematics? A Pedagogical Answer to a Philosophical Question" (Harel 2008) discusses mathematical habits of mind as a central part of the discipline of mathematics.
- *Promoting Purposeful Discourse: Teacher Research in Secondary Math Classrooms* (Herbal-Eisenmann and Cirillo 2009) describes cases of secondary teachers promoting students' mathematical discussions and conversations as part of the problem-solving process.
- *The Young Child and Mathematics, Second Edition* (Copley 2010) discusses the development of mathematical knowledge and thinking beyond answer getting with young children.
- *The Problem with Math Is English: A Language-Focused Approach to Helping All Students Develop a Deeper Understanding of Mathematics* (Molina 2012) reminds us of the importance of mathematical communication and makes recommendations about helping students whose first language is not English as they communicate their processes and their thinking on their way to answers.
- *Classroom Discussions in Math: A Teacher's Guide for Using Talk Moves to Support the Common Core and More, Third Edition* (Chapin, O'Connor, and Anderson 2013) describes how to orchestrate discussions that focus on both the process(es) used and the answer(s) that result.
- *Good Questions for Math Teaching: Why Ask Them and What to Ask, K–6* (Sullivan and Lilburn 2002) and *Good Questions for Math Teaching: Why Ask Them And What to Ask, Grades 5–8* (Schuster and Anderson 2005) offer great examples of questions teachers can ask in support of both better solution strategies and better answers.
- *Mathematics Assessment: Myths, Models, Good Questions, and Practical Suggestions* (Stenmark 1991) is a timeless resource for teachers in designing and administering a variety of classroom assessments that address both the process used and the end result.