Role Model Math Solutions' Marilyn Burns engages students as they go deep into math concepts.

PHOTO: JIM FRANCO

HOW TO

Do Math Right

Marilyn Burns on embracing the Common Core practice standards to teach math more effectively.

BY ERICH STROM

FOR TOO LONG, math teachers and students have relied heavily on procedure. "Yours is not to question why, just invert and multiply" has been the norm, says Math Solutions' Marilyn Burns. Kids inverted away and got the right answers—whether or not they understood the underlying principles. The Common Core is challenging that approach, and demanding more emphasis on understanding, as embodied in the eight new standards for mathematical practice. These standards apply to all grades, and a quick scan of them—"make sense of problems"; "reason abstractly and quantitatively"; "model with mathematics" (see page 41 for the full list)—indicates why. They are, as a group, the foundational skills for working in any of the domains of mathematics.

Young mathematicians should be calling upon these practice standards to move them forward wherever they are on the path—whether they're adding nine apples to four apples or working with geometry or algebraic equations. As Burns puts it, the practice standards are "the vehicles that permeate every aspect of classroom instruction." They steer teachers away from the trap of drilling kids on procedures and looking for "right answers." Students, says Burns, should be thinking the problem out, reasoning, modeling, talking math with one another.

"Here's the mantra for a lesson: If kids could be successful without having to think or reason, then the lesson is not good enough."

That's not just "doing" the standards; that's doing mathematics.

We talked to Burns about the practice standards, and how they shed light on what an effective math classroom might look like. Turns out, they could allow for a lot more talking (by the kids), listening (by the teacher), and learning (by everyone).

What role do the Common Core standards play in mathematical practice?

The eight practice standards are what we do when we do mathematics, no matter what the math is you're trying to learn.

In the traditional math classroom, as it was when I was a student, the teacher taught something, and you were given the homework. It was all about pencil-and-paper proficiency. They didn't really care if you understood. The engagement wasn't there, whereas in social studies or language arts there was discussion going on.

To me, it's all about thinking, reasoning, making sense, and communicating.

So the standards have the potential to move math instruction in the right direction?

We're being given a shot at doing something that makes sense—getting kids to develop understanding. To quote from the standards themselves: The Common Core recommends "a balanced combination of procedures and understanding." That's really common sense-y. And it cautions: "Students who lack understanding of a topic may rely on procedures too heavily."

I think that the Common Core is a great step forward. Will it be successful? The jury is out. But for me, the standards of mathematical practice are pretty glorious.

How should teachers be thinking about teaching them?

Teachers are nervous: "How do we teach the Common Core practice standards?" Wrong question. We don't teach the practice standards. They are the embodiment of how we do mathematics. You're not supposed to teach them; you use them. Nor

Common Sense-y Burns lauds the Core for recommending a mix of procedures and understanding.

PHOTO: JIM FRANCO

are you expected to embed every practice standard in every lesson. Here's the mantra for a lesson: If kids could be successful without having to think or reason, then the lesson is not good enough.

Look at practice standard number 3: "Construct viable arguments and critique the reasoning of others." The implication is, it's not the teacher who is talking and explaining; it's the kids who are talking. That's such a profound shift. If you took just that one, and said the class will be a place where students are constructing viable arguments—explaining their thinking and responding to one another's thinking—then I think we'd be making progress.

What do you think is the biggest challenge teachers face in doing that successfully?

A lot of elementary teachers fear math. You can't teach what you don't understand. The Common Core standards are saying, "You really have to understand this." They make a clear, passionate case for that.

You stress that "doing" math requires communication—talking, listening, discussing—which may not be the math classroom's strong point.

And that's why I'm saying it's not a bad place to start. I was in a class yesterday, modeling for a teacher. I gave a problem that was really too easy for fourth graders. I wrote 99 + 17 = ___ horizontally on the board. I had them figure out the answer, and I had them chat with a neighbor. We said the answer out loud together: "116." Then I said, "We got the answer out of the way. What I'm really interested in is how you got it." The kids had all these ways they thought about it, and my job was to represent their ideas mathematically, connecting their thinking to mathematical representation. I filled the board up with all their work. Then they had to critique the ideas of others and connect it to their thinking. The kids were doing the talking, rather than me doing all the talking. While this wasn't obvious to me when I was a beginning teacher, it seems so obvious now.

THE STANDARDS FOR MATHEMATICAL PRACTICE

1. **Make sense of problems and persevere in solving them.**
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning of others.**
4. **Model with mathematics.**
5. **Use appropriate tools strategically.**
6. **Attend to precision.**
7. **Look for and make use of structure.**
8. **Look for and express regularity in repeated reasoning.**

The practice standards apply to math education at all levels. They are not meant to be taught explicitly, says Marilyn Burns. Rather, they describe "what we do when we do mathematics."

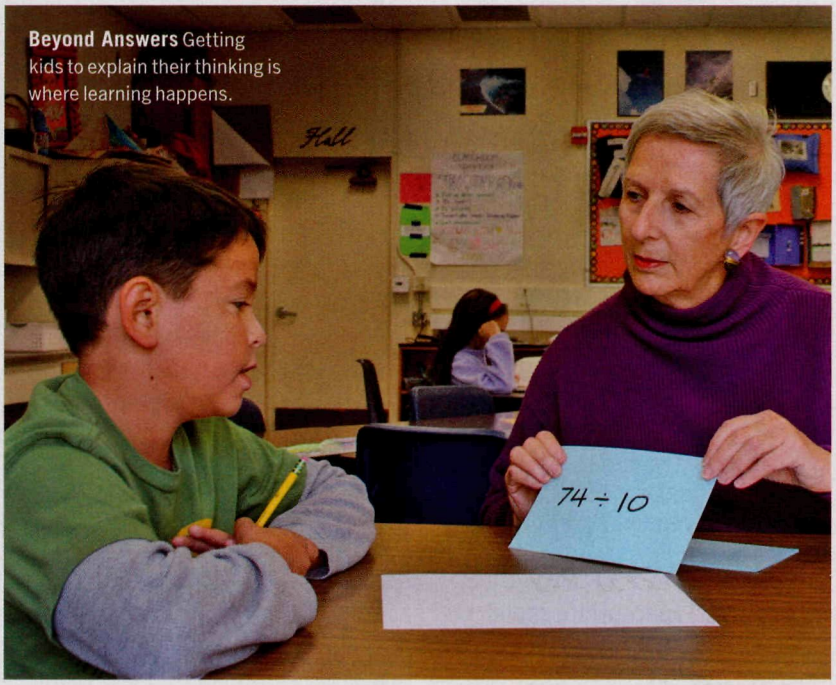
It only takes a simple word problem to engage with them, such as "Molly has 96 pennies and her friend Alice has 39 pennies. How much money do they have altogether?"

Burns says she'll get past the "right answer" stage by having the class say the answer out loud to arrive at the juicy part of having the kids describe for one another the various ways of attacking and breaking down the problem.

One student might have "reached 100" by taking 4 away from 39 and adding it to 96, then adding on the 35 to get 135. Another might have taken 1 away from 96, added it to 39 to get 40, then added 40 to 90, and tacked on the 5. Some students may have done these operations in their heads, others with paper and pencil. Others may have reached the answer using manipulatives to represent the tens and ones. The teacher's job is to fill the board with their work and their thinking, which essentially is a way of "connecting their thinking to mathematical representation," says Burns.

In doing a straightforward problem, and talking out the merits of various approaches, students are making sense of the problem ("it looks like addition...") and reasoning quantitatively. They're using appropriate tools (paper and pencil, manipulatives). They're making use of structures such as place value and the associative property. They're critiquing one another's methods and learning that there are multiple ways to model a problem. Being called upon to explain themselves requires attention to precision. And they will be using "regularity" from their repeated reasoning to develop the very procedures they're calling upon (such as "reaching 100" or "adding the tens, then the ones").

In other words, if kids are doing the work of real math, the practice standards take care of themselves.



Beyond Answers Getting kids to explain their thinking is where learning happens.

"I said, 'We got the answer out of the way. What I'm really interested in is how you got it.'"

And by listening, teachers can gain insight into their students' understanding?

Right. How do you know what kids are thinking unless you're listening to them? The mantra I use is, "As teachers, we ask, we listen, we learn." In my early years of teaching, when I asked a question, I was hoping beyond hope that I'd hear the answer I wanted to hear. And when I heard it, I'd ask the next question. There are so many fallacies there. When I hear the answer I want to hear, I assume that everyone gets it and I can move on. So basically I'm controlling the lesson in a way that reflects not focusing on listening to the students about how they think, not really being interested in what they have to say. That's the shift I want to make in the classroom.

You've also stressed the value of doing the sort of one-on-one formative interviews that are taken for granted in reading instruction.

The world of reading gives teachers tools for having one-on-one conversations with kids. They have DIBELS Fluency and Running Records. They also expect kids to be able to interpret what they've read, to make predictions, to bring understanding to texts. I'm trying to bring those same practices into the math world. It's something that ought to be done. It just seems to me to be common sense.

If you want to find out if kids are reading, you listen to them read. Why in math do we get so excited when they can do the page? I think the practice standards are all about doing the math and not doing the page.

It seems that your new online MRI is designed to be the kind of tool that helps kids "do" the math rather than just complete a worksheet.

I'm trying to make this part of the culture of teaching. What MRI does is ask kids to solve problems mentally (with a few exceptions), hands on the table, no paper and pencil, as a one-on-one formative assessment with the teacher. The questions target pre-sixth-grade Core math standards, so it could be given at the end of fifth grade or used with older kids about whom you have specific concerns. I'm working on developing an MRI for the younger grades, to help teachers at all grade levels gain insight into how their students reason.

Taking away the pencil helps teachers see how kids are really thinking about the numbers?

Yeah. For example, a question we used with fourth graders is 15 x 12. Having them do it

MATH REASONING INVENTORY

The free online formative assessment tool, developed by Marilyn Burns and her MRI team, consists of three parts, based on the Common Core math standards through fifth grade: whole numbers, decimals, and fractions. It leads teachers through one-on-one interviews focusing on core reasoning strategies and understandings, and provides individual and class progress reports. There's also a rich array of resources, videos, and practice materials to train teachers to administer the MRI effectively. For more information, visit ***mathreasoninginventory.com.***

PHOTO: SUSAN BARCLAY

in their heads gets at their ability to use the distributive property, breaking a number apart to multiply. If you don't understand that, algebra is going to be very difficult.

The MRI also provides a format for the teacher to quantify each student's numerical reasoning.

It gives you back a report—for each individual kid, and for the entire class. You also can get an item analysis for each question. It's not a score, not a number or a letter; it's information about what your students demonstrate, what they can do, and where the deficiencies are in your classroom. So it's a real tool for making instructional decisions.

And it's making sure the practice standards are being addressed.

Completely. You're giving them a problem. You're asking them to reason quantitatively—that's part of it. You're asking them to do all that stuff. It's all there.

More broadly, it seems like the MRI offers a model for classroom communication.

It provides teachers a way to dialogue with kids. It gives teachers practice listening to understand how kids are reasoning, which isn't always easy. For example, "Molly ran 1.5 miles a day for 20 days. How many miles has she run?" These are problems teachers expect their students to be able to solve correctly. I'm interested in how the kid solves that, and how you hear how the kid solves that. My life has been about improving the quality of teaching, and my hope is that having these conversations with kids will support what teachers do in the classroom. How could you not ask these kinds of questions in the classroom? □

Marilyn Burns is the founder of Math Solutions (mathsolutions.com), which has provided professional development and resources for almost 30 years.

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