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How the Common Core Shifts the Focus of Mathematics Learning

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Imagine two different fifth-grade classrooms, each learning to add 1/2 + 1/3. In one, students succeed when they can remember the correct calculation procedure and arrive at the right answer: 5/6. But in the other classroom, guided by the new Common Core State Standards, getting the right answer is not enough.

The new standards shift the emphasis from learning a sequence of computation procedures to building an understanding of key mathematical ideas. Students are expected to be able to explain mathematics concepts and to justify problem-solving solutions. In the example of adding 1/2 + 1/3, students must not only learn to convert these into equivalent fractions with a common denominator, they must also understand when to apply this procedure and *why* it works.

Students aren't the only ones facing a steeper learning curve. As districts across the country move toward full implementation of the Common Core State Standards (CCSS), many teachers are tackling the dual challenges of improving their own mastery of mathematics concepts and making fundamental changes in the way they teach the subject.

Unpacking the concept of "conceptual"

"The biggest shift in mathematics instruction driven by the CCSS is that teachers are required to teach mathematics more conceptually, not just procedurally," says Cynthia Lee, formerly a Senior Program Associate with WestEd's Local Accountability and Professional Development Services (LAPDS). Lee says that prevailing practice in recent decades has emphasized teaching mathematics as a series of computation procedures aimed at quickly getting the correct answer. But the CCSS require students to *think mathematically* and demonstrate that thinking orally, through drawings, and in writing. Right answers, while still important, are less often the criterion for a successful lesson.

For many teachers making the shift to more concept-based mathematics instruction, the new methods can look a lot like their old ways of teaching. Careful unpacking of "conceptual" is required. To illustrate, during CCSS training Lee often describes a commonly taught procedure for converting fractions such as 1/2 and 1/3 into two respective equivalent fractions with the same denominator so that the fractions can be added. In this example, the procedural teaching can contradict important concepts that students need to learn. Once students have determined that the lowest common denominator is 6, Lee explains that the teacher often instructs them to "multiply the top and bottom number of the fraction by the same number; always do the same thing to the top as you do to the bottom." Although that may work procedurally, Lee points out that "mathematically speaking, it is simply *not accurate*."

To build mathematical understanding, she emphasizes, students must understand that they can convert a fraction to an equivalent fraction with a different denominator by multiplying the original fraction *by a fraction equal to the number 1*. In this example, students would multiply 1/2 by 3/3 and would multiply 1/3 by 2/2, converting each to sixths, allowing the students to calculate a sum, 5/6. Using and justifying this strategy requires students to solve the problem mathematically. To do so, they must understand *why* they multiply 1/2 by 3/3, and *why* they can multiply any fraction by a fraction equal to 1 and get an equivalent fraction.

Teaching conceptually, Lee says, raises the cognitive demand on students—from memorizing a procedure to applying a mathematical idea to a problem. This yields both immediate and long-term benefits. "First, if students don't understand *why* to use a procedure," she explains, "they get confused about *when* to use it. As a result, they may apply the procedure indiscriminately, whenever a problem contains a fraction." On the other hand, Lee adds, when learning to add or subtract fractions, if students learn that they can create an equivalent fraction with a different denominator by multiplying the original fraction by a form of the number 1, this puts them on the path to understanding the "flexible" usefulness of the number 1 for solving many types of problems. "Learning to use the number 1 when solving problems will help students in their mathematics coursework forever," she asserts. For example, students in later grades will need to understand that an X in an equation with no number next to it is actually 1X.

Referencing the "fewer, deeper" elements of the CCSS tagline, Lee says, "You can easily spend two or three days just teaching students about equivalent fractions."

Implementing the new standards at the classroom level

Marsha Cody is a seventh-grade mathematics teacher in the Alamosa School District in south-central Colorado, one of several districts where Lee and her LAPDS colleagues provide CCSS-related professional development and coaching. Cody has taken on several kinds of responsibilities for CCSS implementation over the past three years, at the state, district, school, and classroom levels. Not surprisingly, she has strong convictions about the support teachers require during the transition to CCSS.

"In Colorado, there is a huge disparity between the academic content we used to teach in fourth-, fifth-, and sixth-grade mathematics and what we teach now," Cody says. "We can't just expect teachers to know how to bridge that gap. Students currently coming through the pipeline haven't had CCSS-level training in their previous grade, making the load even more daunting. The professional development we offer has to make the transition to the new standards 'doable' or teachers will become frustrated and overwhelmed."

Time, resources, and administrative support are among the top requirements for effective professional development, according to Cody. She and her math department colleagues at Ortega Middle School benefited from their administrators' commitment to implementing the CCSS, she says, because "getting" the deep shifts required by the CCSS standards takes time and hands-on experience. When she helped mathematics teachers two years ago to develop common formative assessment items, she had her biggest "aha moment"—even though she'd already been working with the standards for years at that point. "It was clear that the process of having to describe in detail what students would know and be able to do is what made the standards really start to 'come alive' for teachers," Cody says.

An example of a formative assessment item they developed together to address the fifth-grade standard for fractions is the following word problem:

> **Matt is in charge of making punch for a party. The recipe calls for 1/4 cup of juice and 2 1/3 cups of soda. He is planning to make 5 batches of the punch to serve everyone. How much juice and soda will he need to make all the punch? Show all your work and explain your thinking.**
>
> **A: He will need _____ cups of soda and _____ cups of juice.**
>
> **B: Explain how you solved the problem.**

Cody also knows from experience that it's possible for teachers to participate in professional development and not reach the kind of insights that can lead to more effective teaching. "If teachers don't take in the bigger meaning of the CCSS—for example, if they don't focus in on the significance of key verbs used in the standards, like *understand, justify, model, explain,* or *draw,*" Cody says, "it's really easy for them to believe that they understand and can teach the standards, but then fall right back into teaching the way they've always taught."

Supporting the shift

Ortega Middle School principal Susie Paulson, who was a mathematics teacher before becoming an administrator, has similar ideas about supporting teachers—and some strategies to help address the challenges. "An important part of my role in making this process work is to be in the classroom providing support to teachers as they struggle with the challenges they face." Access to an external resource like LAPDS, which provides regular classroom observations and ongoing guidance, is also valuable for keeping the multifaceted process on track, Paulson notes.

Because of her own training in a more conceptual approach to teaching, Cody has firsthand experience of how such teaching changes student learning. "We know that when cognitive demand is higher," she says, "and students are supported to persevere in using mathematics concepts to solve problems, that the learning lasts." Teachers and schools with a grounding in what is variously called "student-centered," "inquiry-based," or "constructivist" pedagogy are definitely at an advantage in implementing the CCSS, Cody adds. "Instructional approaches that involve a lot of classroom discourse about applying mathematical knowledge to solve real-world problems—where students learn to justify and evaluate their mathematical thinking—put learning at such a different cognitive level."

Cody has found that as teachers make the shift toward this type of instruction, positive student responses start to become a source of motivation for them. "Teachers are excited when they realize that students can deepen their understanding of mathematics ideas through investigation and discourse," Cody says. "Teachers often come to this realization when they have the opportunity to participate in professional development that provides those same kinds of learning experiences."

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