Tips and Tricks: As an Instructional Leader, How do I Influence Math Instruction?

When we first began to hear about the new core's "deeper not wider" approach we were curious. But soon after we were almost underwhelmed. At first glance not much had changed (or so we thought).

We agreed that Math was a sore spot. We didn't have to look far or hard to find students who struggle in Math. One teacher surveyed her students to see which subject was their favorite. Two chose Math.

Next we asked ourselves who loved teaching math. Guess what we found.

Background knowledge:
So our next step was to build background knowledge. Several teachers and I attended the summer Core Academy. Then we went back the next year, too.

I signed up for David Smith's Elementary Principal's Math Academy. Dave introduced us to math tasking and modeling, took us for site visits, and brought in key presenters such as Dr. Damon Bahr who took us through a math modeling activity that really cemented the why and the "how to" of math modeling and discussions with a "Launch/Explore/Discuss" approach to math tasking.

A few of my staff went with me to visit Brockbank Elementary and met Principal Alison Hansen. There we watched Launch/Explore/Discuss in action. One key was hearing Brockbank report that all faculty were accountable for learning all the math, not just the concepts that fit their grade level. "We can't let someone screw it up for the rest of us" was how we took it. (Some of their training was based on "Developing Mathematical Ideas, Parts 1, 2, & 3 by DALE SEYMOUR PUBLICATIONS)

A new direction:
What we discovered was a richer model for teaching ,one where objects (manipulatives) and models and student discussion about their mathematical ideas made problems real and concrete.

Then we began to discover something we missed the first time we read the core. Many of the standards for Math include references to math models. Remember how we originally thought little had changed in the new core? Not so. Read the new math core. On first blush the concepts haven't changed much. There's still addition, division, fractions, ratios. The topics haven't really changed.

What has changed is that each standard often included the word "by." We've learned that "by" is a clue to the real math understanding the core expects.

For example, look at first grade: "Teach addition and subtraction within 20". Not really all that tough. But then look deeper. We are asked to do this ***by*** modeling "add-to", "take from", "put together", and "take apart" models. Dig deeper and you know to look for students who add ***by*** using "counting all" strategies, "counting on", "doubles", and "making ten", for starters. That's only addition.

Try fourth grade: students are asked to do more now that just multiply or divide. They are asked to understand the math model ***by*** using "area diagrams"? For sixth grade, ratios become more than numbers separated by a colon when we are ask teachers to make connections with students ***by*** using

“tape models” and “double number lines”. “By” clues us in to a list of models and manipulatives and ways of making math visual, concrete and meaningful is extensive, deep, rich, powerful, and necessary.

Learning to examine our Mathematical Thinking:
This fall perhaps the best thing that could have happened to unify our faculty’s math focus occurred almost by accident. Our leadership team was planning a back to school all day math institute. While we had used PLC time to do some hands on tasking with the entire faculty, we knew we needed to go deeper. About that time David Smith forwarded a link to an online “Maths” course from Professor Jo Boaler of Stanford University. We decided to share some of her video discussion with the faculty. What evolved was that we used much more of her material than we intended. We showed a clip. We stopped, discussed, and the discussion was rich and thoughtful. We threw a math task or two in for variety, but then by popular demand we came back to the video discussion. Dr. Boaler helped us with a common philosophy and background knowledge, but more especially we came away believing “all students can learn—Math!”

(The course is offline for now, but will be back up and amped up in the spring—I’m sure Dave will be sending it out on his listserv).

Next steps:
So what remains to be done? Continue to follow the path. We hope to make PLC’s even more data driven (see also Bambrick: Leverage Leadership”). In grade level PLC team meetings teachers unpack the “by” models. They write common assessments and do “within test” item analysis and align instruction to those assessments or district benchmarks or SAGE.

It will take longer. It will seem slow. Teachers need time to do this planning, and tighten the focus and the process on “complete” teaching. We will look for differences in how high, medium, and low students think and understand,and hope to implement learning experiences that are richer and deeper.

Is it sustainable?
We’ve set the stage and we believe we have buy-in. We hear teachers leading richer discussions and probing students understanding. There is less teacher talk. There is more listening to students with the purpose of understanding what they see and how they see it. We are growing in the way we look at assessments and gather feedback. Homework is purposeful. Students are growing in their ability to think aloud in front of peers. We are truly just getting started, but there is purpose and direction. We have a long way to go before we hit “complete”, but the journey is amazing.

Further Resources:

North Carolina’s core guide has pictures. Utah’s core guide includes the pre-requisite knowledge. See also Georgia, Jordan and Granite’s math websites. Want the quick answer in movie form? Access Illuminations.com or Ccssmath.org then click resources for a core aligned resource list.)

Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K-5 Parrish, Sherry
Childrens Mathematics/Cognitively Guided Instruction Thomas Carpenter, et al
Good Questions for Math Teaching: Why Ask Them and What to Ask, K-6 Pat Lilburn, et al

Developing Mathematical Ideas, Parts 1, 2, & 3 DALE SEYMOUR PUBLICATIONS

And be sure to visit David Smith's Math Blog: http://utahelementarymath.wordpress.com/ and the USOE Elementary Math website: http://www.schools.utah.gov/curr/mathelem/

Tips and Tricks: As an Instructional Leader, How do I Influence Math Fluency?

Posted on November 15, 2013by dsmith1953

As we all get used to deeper standards and different expectations for Math, I feel some urgency to write a bit about fluency in mathematics.

What does fluency mean? For some, perhaps most of us, when we hear fluency we think of speed. Those who are fluent are those who can do the most facts the fastest. However, fluency is defined in Adding it Up: Helping Children Learn Mathematics, the seminal work on research in what works in elementary mathematics teaching and learning as follows: "Procedural fluency refers to knowledge of procedures, knowledge of when and how to use them appropriately, and skill in performing then flexibly, accurately, and efficiently." The core does define fluency as being fast and accurate when using mathematical procedures, however speed is not the major factor.

Now, none of that should be read to mean that students shouldn't memorize math facts. As shown in the chart above, kindergartners should know addition and subtraction facts up to five (5 + 5 and 5 – 5 being the limits) by memory by the end of kindergarten. Likewise, third graders are expected to know from memory the products of all combinations of two one-digit numbers (up to 9 x 9) by the end of third grade. Getting the facts down is important to later success in mathematics, including Algebra and beyond. ***Memorizing, however, is just one part of fluency.***

In order to really be fluent, students must ***understand*** the mathematics of the facts they are expected to memorize. Fluency comes at the endpoint of clear ***learning progressions*** that are well documented in the core standards that lead to conceptual understanding. By spending a great deal of time working with and reasoning about numbers and the operations that combine them students come gradually to that fluency. (For more info, search youtube for the title "**Mathematics Fluency: A Balanced Approach")**

As students work toward being fluent with addition, subtraction, multiplication, and division they should have multiple experiences, guided by the standards in the core, that help them along the path. ***They should have plenty of opportunities to use concrete and pictorial representations of math problems.***
As students work toward addition and subtraction fluency they may also use such mental math strategies as:

- Counting on: 8 + 4 = □ (8 …9, 10,11,12)
- Counting back: 12 – 4 = □ (12…11, 10, 9, 8)
- Making tens: 5 + 7 = □ (5 = 2 + 3 so 3 + 7 = 10 therefore 10 + 2 = 12)
- Doubles: 6 + 6 = □
- Doubles plus/minus one: 6 + 7 = □ (6 + 6 + 1 or 7 + 7 – 1)
- Decomposing a number leading to a ten: 15 – 7 = □, so 15 – 5 = 10, therefore 10 – 2 = 8)
- Working knowledge of fact families/related facts: 3 + 9 = 12 so 12 – 9 = □

As they work toward fluency in multiplication and division they may use such mental strategies as:

- Doubles (2 x 2 = 2 + 2)
- Double and double again (4 x 2 = (2 x 2) x 2)
- Halve, then double (6 x 8 = (3 x 8) + (3 x 8))
- Doubles plus one more set (3 x 7 = (2 x 7) + 7)
- Add one more set (6 x 7 = (5 x 7) + 7)
- Decomposing into known facts (i.e., use facts you know to solve the ones you don't)
- Halves (12 ÷ 2 = 6)
- Multiplying by zero and one
- Patterns in 9's
- Fact families
- Number bonds

Other experiences include gaining a firm understanding of place value and the properties of operations. These understandings are particularly important when students begin working with multi-digit numbers in any of the four operations.

Now, just a word about ***timed tests***. Timed tests are widely used through the state as a means of developing fluency in math facts. Timed tests, however, have become somewhat controversial. Dr. Jo Boaler, a mathematics education professor at Stanford has conducted research showing that "students as young as five years old are given timed tests-even though these have been shown to create math anxiety in young children." (http://joboaler.com/timed-tests-and-the-development-of-math-anxiety/) . Dr. Cathy Seeley, former president of the National Council of Teachers of Mathematics, in her book Faster Isn't Smarter, states, "While computational recall is important, it is only part of a comprehensive mathematical background that includes more complex computation, an understanding of mathematical concepts, and the ability to think and reason to solve problems. Measuring this one aspect of mathematics— fact recall—using timed tests is both flawed as an assessment approach and ***damaging to many students' confidence and willingness to tackle new problems."*** She further states, " ***Overemphasizing fast fact recall at the expense of problem solving and conceptual experiences gives students a distorted idea of the nature of mathematics and of their ability to do mathematics***. Some students never survive this experience and they turn away from mathematics for years, sometimes forever. Having experienced timed tests when they were students, many adults believe that accurate, fast computation is the most significant part of mathematics. When pressed, many of these adults who dislike or fear mathematics attribute these negative feelings to experiences from their school years, especially the use of timed tests." (http://www.mathsolutions.com/documents/9781935099031_message18.pdf)

Fluency in mathematics comes about from a clear understanding of mathematical ideas. It comes as students reason about numbers and use them in a variety of contexts and with a variety of representations. Teachers should use a wide variety of experiences to help students memorize the basic facts and to be fluent with other procedures. Mental math strategies are extremely helpful. Number Talks can help students develop those mental strategies. See http://www.insidemathematics.org/index.php/classroom-video-visits/number-talks for some video examples of number talks in classrooms. Games are also useful. Just google "math fluency games" to find many on-line examples. Certain software products can also help. Think creatively and mathematically!

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