2013

EDUCATION WEEK

SPOTLIGHT

On Math and the Common Core

Editor's Note: The Common Core State Standards will change the grade levels at which math content is introduced, while pushing aside other topics altogether to achieve greater depth. This Spotlight looks at these changes, including how educators are building new e-textbooks, reshaping instruction in the classroom, and preparing for new assessments in math.

TABLE OF CONTENTS:

Published April 25, 2012, in Education Week

Big Shifts Anticipated for Math Instruction

Some topics will be introduced earlier, some omitted, and students will have to show their understanding

By Erik W. Robelen
Ellicott City, Md.

Nena F. Hupp pauses from reading her kindergartners the picture book *Let's Count* to help them better understand the math assignments they are about to tackle in small groups.

Stephen Voss for Education Week

Nena Hupp helps Chase Toler in her class at Worthington Elementary School. Students in the Howard County, Md., district are being taught math conceptsat an earlier age.

"Remember, when you get to 10 dots, a better way is to represent those 10 dots with just a stick," said Ms. Hupp, who teaches at Worthington Elementary School in this community near Baltimore. "It takes us forever to have to count all those dots. Mathematicians were smart when they came up with that idea, because it makes it so much easier."

Prior to this school year, kindergartners in the 50,000-student Howard County district—and in public schools across Maryland—were not expected to learn about representing tens and ones, a building block for understanding place value, explains Kay B. Sammons, the district's elementary-math coordinator.

"Prior to the common core," she said, "it was a 1st grade objective."

That's now changing, along with a whole lot more.

Across the nation, big shifts are afoot as 45 states and thousands of school districts gear up to implement the Common Core State Standards in mathematics. The standards will change the grade levels at which some content is introduced, push aside other topics altogether to achieve greater depth, and ask students to engage in eight "mathematical practices" to show their understanding, from making sense of problems to reasoning abstractly and constructing viable arguments.

Some districts are already working hard to make the transition.

In Albuquerque, N.M., more than three dozen 4th and 8th grade math teachers are piloting the new standards this school year. In fact, several of them starred in videos recorded last fall in their classrooms to demonstrate lessons.

In Boston, teams of teachers and teacher-leaders are developing new curriculum-guidance documents, grade by grade, and combing through the district's textbooks and other instructional materials to see how they fit with the common core, what's useful, what's not, and where material should be reordered or supplemented.

In Howard County, the math standards were inaugurated for kindergarten this school year, with the 1st and 2nd grades to follow in the fall. To help prepare, district math leaders brought together some teachers, including Ms. Hupp, to serve in a focus group that delivered feedback on draft curricular materials for kindergarten.

"We would create things and get reactions from the teachers, asking: 'Does this make sense to you? Would you change this?' " said Ms. Sammons. "They gave us some terrific insights into how to develop this tool that is useful and user-friendly."

The suburban district also has started to communicate with families, whether at back-to-school events, in newsletters, or on the district website, to make sure they understand the changes coming. In fact, the district is planning a broader public relations campaign, with brochures, public forums, local TV spots, and even podcasts.

Gail F. Burrill, an academic specialist at Michigan State University and a former president of the National Council of Teachers of Mathematics, suggests that bringing families on board is critical.

"It's not going to be enough just to support the teachers in making this change," she said, "if the broader community doesn't understand and support it."

'Flipping a Switch'

States and districts face a host of challenges in adapting to the standards, from ensuring that teachers are adequately prepared and supported to overhauling the curriculum and, more broadly, figuring out exactly what exemplary classroom practices tied to the standards should really look like.

The transition is tricky since, even as districts are beginning to move toward the new standards, common assessments pegged to them have yet to be developed. District officials note that, for the time being, schools will be judged on existing state tests that don't align to the new standards.

Meanwhile, many state and district officials say textbook publishers are scrambling to catch up with the common standards and few, if any, materials that truly align are available.

In addition, it's not simply a matter of flipping a switch to have instruction at all grade levels reflect the new standards. After all, a lot of math content builds on prior learning.

"You can't say, from one year to the next, we're going to go 100 percent common-core standards, because students aren't coming with the [prior knowledge] to embrace it," said Jesch A. Reyes, the director of math and science for the 405,000-student Chicago district, which has a group of "early adopter" schools in which teachers are starting to implement the new standards and share lessons learned. "Over the next several years, we're ... introducing them incrementally, building teacher capacity and student capacity."

Many district and state officials say they expect, to varying degrees, that the new standards will be tougher for students to meet.

William Barnes, the Howard County district's secondary-math coordinator, describes the new standards as "very different" and "much more rigorous" than Maryland's prior math standards.

"This is fewer, higher, so that's a significant shift in paradigm for Maryland," said Mr. Barnes, the immediate past president of the Maryland Council of Teachers of Mathematics.

On average, students will be expected to master about half as many standards as before, he said, but they'll be asked to understand that content in much greater depth.

"Here in Illinois, a lot of the content taught at each grade level is being pushed down to other grade levels, even several grades down," said Mr. Reyes from the Chicago school system.

His colleague, district math specialist Matthew S. McLeod, adds that while many teachers in the city's early-adopter schools seem enthusiastic about aspects of the standards, such as the eight mathematical practices that are a key focus of their work right now, the teachers are apprehensive about the new expectations.

"They are panicked about how hard it's going to be to get our students to this level of rigor," he said.

An array of initiatives have emerged to ease the transition to the new standards. For one, the 11 states, plus the District of Columbia, that won a slice of $4 billion in federal Race to the Top aid have had extra money to fuel professional development and devise new resources to help schools, among other activities.

Advisory Group

Meanwhile, a set of leading national groups, including the NCTM, the Association of State Supervisors of Mathematics, and the Council of Chief State School Officers, have formed the Math Common Core Coalition to offer expertise and advice on the standards.

One new resource touted by several math educators is the Illustrative Mathematics Project website, which aims to supply high-quality math tasks, all carefully vetted by math experts and teachers, to illustrate the range and types of work that students will experience in a "faithful" execution of the standards.

William G. McCallum, a University of Arizona math professor who spearheaded the project and also was a lead writer of the common standards, said plans are in the works to expand the site to become a thriving online community of math educators with expertise in the new standards and how to translate them for the classroom.

'Stronger Foundation'

The Howard County district, one of Mary-

Who Said Mastering Mathematics Can't Be Fun?

One-to-one math learning that just feels like play. It really works. And aligns to the Common Core.

A proven, one-of-a-kind math learning program that adapts, so kids can easily go to the place where confidence and math mastery grow with every click.

- ✔ Integrated assessment, instruction and practice that identifies and differentiates to address gaps in each student's comprehension.
- ✔ A suite of academic progress reports, including a report that offers a real-time view of individual student progress against the CCSS.
- ✔ More than 1,000 adaptive lessons that build conceptual understanding and fluency.

dreambox® LEARNING

Call 877.451.7845 for information, and visit **dreambox.com/ewspot** to download Dr. Francis (Skip) Fennell's White Paper.

You dreamt it. We built it. Intelligent Adaptive Learning

land's top-performing school systems, is working on many fronts to implement the standards, from providing professional development to revamping its curriculum, in an effort to be sure schools are ready for all the changes to the what, when, and how of math instruction envisioned with the common core.

On the when issue, for example, Mr. Barnes said about 40 percent of concepts now taught in Algebra 2 will shift to Algebra 1.

At kindergarten, the only grade level where the district has fully implemented the standards, the core focus is number development and spatial thinking.

"The children will have a stronger foundation in number as they move into 1st grade than they historically did," said Ms. Sammons, the elementary-math coordinator.

In the past, for instance, kindergartners were expected to be able to count up to 31, by ones; the new standards ask them to count to 100, by both tens and ones. In addition, she said, they are asked to start counting from any number.

The district has a three-year transition plan, she said, so that by 2013-14 all grade levels will fully reflect the new standards.

It is developing a detailed curriculum—described as a set of "living documents"—that will evolve and grow to meet the needs of educators and students.

The material, posted on a wiki site, walks Howard County teachers through the math standards one by one. First, the standard is presented. Then, the district translates it into plain language with further explanation for teachers. The wiki site identifies common student misconceptions to watch out for, provides a sequence map of the curriculum and a progression chart to help see where students need to be, with benchmarks along the way. It also identifies a host of instructional resources, as well as information on formative and summative assessments.

"We really unpack what's supposed to be going on in the standards," said Ms. Sammons.

Ms. Hupp, one of three kindergarten teachers at Worthington Elementary, raves about the wiki site, saying it's a vital resource. Overall, she's upbeat about the new standards and her experience so far teaching them.

"I like it so much better," said Ms. Hupp, a 15-year teaching veteran who notes that she is now better able to meet individual children where they are academically.

One big challenge, she said, is figuring out how to reach the deeper level of math understanding the standards espouse.

"The question is: How do you dig deeper?" she said. "For anybody who starts teaching the common core, that is going to be the challenge."

But the wiki guidance has been helpful in identifying sample lessons to foster that, she said.

One especially welcome change, she said, is that with fewer math concepts to cover, she has time to better gauge whether a student truly understands the material.

"Some of the kids that [met] the standard at the surface level were missing some pieces," she said. "You could start picturing what their knowledge of that skill is, whether it was just memorization or whether they had it."

A Taste of Common Core

Meanwhile, with support from the Seattle-based Bill & Melinda Gates Foundation, a handful of urban districts have gotten started on implementing the common core. Six systems, including Albuquerque and Boston, received $500,000 planning grants in 2010. Those six, along with two others, are also "lead districts" in a common-standards project of the Council of the Great City Schools, which received a $4.6 million grant from Gates last year for its work. (The Gates Foundation also provides support for coverage of K-12 business and innovation in *Education Week*.)

The pilot project in the Albuquerque school system is mainly aimed at testing approaches to support teachers and schools in implementing the standards in math and English/language arts, from their use of classroom materials and new curriculum maps to administering periodic student assessments and the delivery of professional development.

"The goal was for them to be able to get a taste of the common-core implementation and for us to get feedback so that we know how we should go about this districtwide, what worked, what didn't," said Gina Middleton, who is managing the district's pilot program.

She's heard a lot of positive feedback from educators.

"What they love, love, love is ... giving the depth to content and not teaching so much of the breadth," said Ms. Middleton, "so there are less standards, but they are dense, very compact."

Holly D. Zaluga-Alderete, a math teacher in the city's Polk Middle School, echoes that point.

"I don't have a mile-long list of standards to cover," she said. "For example, with the Pythagorean theorem, in the past, we would say, 'This is the Pythagorean theorem and how we use it' and move on. This year, we could get in depth, how it worked, the ins and outs ... and knowing the whys."

She added: "It's a lot more rewarding and letting me be a teacher."

One big concern among participating teachers, said Ms. Middleton, is the lack of resources to show them what the standards should look like in the classroom.

"Teachers have been craving to see it in action," she said.

As one remedy, several math teachers, including Ms. Zaluga-Alderete, agreed to step in front of a camera to demonstrate lessons. In Boston, a top priority is "organizing and sequencing the curriculum," said Linda P. Chen, the 57,000-student district's deputy chief academic officer.

The district named teams of math teachers and teacher-leaders at every grade level. Those work groups recently began sitting down with the state's version of the common standards to redesign curriculum-guidance documents.

"Their charge is to become experts with the [new standards] and to use this expert knowledge to assist" the district in overhauling its curriculum, said Christine M. Hall, the school system's senior director of second-

Standards for Mathematical Practice

The common standards in mathematics do not simply address academic content. They also outline a set of eight Standards for Mathematical Practice, which describe ways in which students ought to engage with the subject matter as they grow in mathematical maturity and expertise throughout the school year.

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

SOURCE: Education Week

ary math.

By early June, each group is to complete work on a set of documents that identify the "scope and sequence" of instruction for their grade level, detailing the standards to be taught in each unit and the time spent on them. Also, each group will provide exemplars of problem types to use in class, as well as sample tasks, to illustrate the math comprehension that should be evident throughout the year, said Ms. Hall.

"Our goal is ... that teachers can leave for their summer vacation with something in hand that clearly articulates the major shifts of the curriculum under the common core," she said. "While there are major shifts, this will be a fluid process, because you can't just say we're going to teach 6th grade anew, you need to attend to the transition."

The work groups also are poring over the district's current textbooks and other classroom materials "with a very critical eye, saying, 'We know we have this, we know what we are being called to teach,' " Ms. Hall said. "How do we selectively choose the problems and questions in our textbook? How do we perhaps rephrase introductions to lessons, how do we reorganize lessons in units to attend to the new focus and coherence of the common core? This is a work in progress."

Indeed, Ms. Chen, the deputy chief academic officer, said that her district, like some other large urban systems, is holding off on buying new textbooks because of budget constraints and because publishers still have work ahead.

"There really, truly is not something out there that you can buy that is aligned," Ms. Chen said.

Just Do It

Although many educators say it's a daunting task before them to feel prepared for the common standards, Ms. Hupp from Worthington Elementary said the key is just to plunge ahead.

"We're feeling so much better about it," she said of the school's kindergarten team. "With anything new, you're going to feel a lot of anxiety. ... The only way you can feel good about something is actually diving in and doing it."

Coverage of "deeper learning" that will prepare students with the skills and knowledge needed to succeed in a rapidly changing world is supported in part by a grant from the William and Flora Hewlett Foundation, at www.hewlett.org.

Published May 9, 2012, in Education Week

Math Teaching Often Doesn't Fit With Common-Core Standards

Topics broached at unprescribed grade levels

By Catherine Gewertz
Atlanta

Many mathematics teachers are teaching topics at higher or lower grade levels—and for more years—than the Common Core State Standards recommend, according to preliminary results from new research.

That finding suggests that when the new standards are fully implemented, many math teachers could face significant shifts in what they will teach.

The information is part of a research effort led by William H. Schmidt, a Michigan State University professor who is widely known for an influential 1996 study that found the typical course of study in U.S. math was "a mile wide and an inch deep."

His new research, which does not yet have a release date, examines a nationally representative group of more than 13,000 K-12 math teachers and 600 district curriculum directors in more than 40 states. It seeks to gauge their readiness to put the common standards in math, which have been adopted by 45 states and the District of Columbia, into practice. Early results were presented at a conference of the Council of Chief State School Officers here April 19.

Mr. Schmidt's team at Michigan State's Center for the Study of Curriculum, in East Lansing, asked the curriculum directors when key topics in the common-core math standards were first introduced, and in what grade levels those topics continued to be taught.

They found that typical coverage of the topics in common-core standards lags two to three years behind the grades envisioned in the common core, and persists longer.

Key topics introduced in 2nd grade in the common standards, for instance, are currently introduced between 1st and 3rd grades, the study says. The variance was even wider in middle school: Topics that the common core introduces in 6th grade are now introduced between 3rd and 8th grades, Mr. Schmidt's research shows.

Additionally, topics envisioned as unique to a given grade in the common standards now persist for multiple years, the study found. Focus topics of the standards at the 4th grade level, for instance, show up in classrooms from 1st through 8th grades, according to the research.

Gauging Attitudes

Teachers appear to be reluctant to shift the grade at which topics are taught, the study's findings suggest. Only one-quarter said they would drop a topic if the common standards specify that it be taught at another grade level.

Responding to surveys and discussing the standards in focus groups, math teachers overwhelmingly supported the standards, which emerged two years ago from a project led by the CCSSO and the National Governors Association. Nine in 10 of the teachers reported that they had heard of the standards, and seven in 10 said they had read them. Ninety percent said they liked the new learning guidelines.

"By and large, opposition to the common core is not coming from teachers. They just want support to teach it," Leland Cogan, a

Michigan State University research associate who works with Mr. Schmidt, told state representatives as he presented the preliminary findings at the CCSSO gathering.

Nine in 10 of the K-6 teachers said they liked and would teach the standards. That figure slipped to 85 percent in grades 7 and 8, and to 82 percent in high school.

Nearly 8 percent of the teachers surveyed in grades 1-3 said they didn't like the standards but would teach them anyway. Nine percent of those in grades 4-6 said the same thing. Discontent correlated with grade level: More than 13 percent of the math teachers in grades 7 and 8 said they didn't like the standards but would go ahead and teach them. In high school, the figure was more than 16 percent.

Fewer than 1 percent of teachers at all grade levels said they "don't like and won't teach" the standards.

Old vs. New

Other findings raise the question of whether teachers understand the differences between their states' former standards and the new ones, Mr. Schmidt said in an email. When they viewed sample topics for their respective grades, eight in 10 reported that they reflect "pretty much the same" content as their states' previous standards.

"The data suggest that most teachers do not recognize how difficult" it will be to move from their states' former standards to the new ones, Mr. Schmidt said.

"Given their willingness, I remain optimistic," he said, "but I believe we have to make them aware of how different these standards are and provide them with materials that both make them aware of the differences and provide them with materials to help in the implementation."

Large numbers of teachers feel unprepared to teach topics in the new standards, the study found.

One-third reported that they had not taken part in any activity designed to help them implement the new standards. And large proportions—as low as 20 percent and as high as 75 percent—reported feeling unprepared to teach some common-core math topics.

When asked to choose possible obstacles to putting the new standards into practice, teachers put a lack of parent support (49.7 percent) and the need for textbooks that support the standards (28.9 percent) at the top of their lists. Concerns about state tests' alignment to the material also was often named (28.8 percent), along with students' difficulty learning the material (20 percent) and a "lack of needed mathematics knowledge among teachers" (15 percent).

Published August 8, 2012, in Education Week

Publishers' Guide for Mathematics Stresses Focus

By Erik W. Robelen

A new set of "publishers' criteria" crafted by the lead writers of the common core in mathematics is intended to help reshape K-8 instructional materials nationwide by spelling out what it means to align faithfully with the math standards adopted by 45 states and the District of Columbia.

The document blends general guidance with some real specifics, such as suggesting how long textbooks should be—fewer than 200 pages at the elementary level—and at what grade level it's appropriate for chapter tests to address particular topics.

A key mantra is the standards' push for focus—covering fewer topics in greater depth—which the authors acknowledge "can seem like hard medicine for an educational system addicted to coverage."

Some in the education and publishing fields have offered generally favorable reviews of the 24-page document, which has been endorsed by several prominent organizations that provided feedback on early drafts, including national groups representing governors, chief state school officers, state boards of education, and large urban districts, as well as Achieve, a Washington-based nonprofit organization that managed the process for developing the Common Core State Standards.

A similar document for the common English/language arts standards—first issued last year and endorsed by the same five organizations—was revised this spring.

"I believe that, in general, publishers will welcome the deeper level of clarification represented in the [math] criteria," said Charlene F. Gaynor, the chief executive officer of the Wilmington, Del.-based Association of Educational Publishers. "Much of the document sells the overarching pedagogy of focus, coherence, and rigor, which, for most publishers, is like preaching to the choir."

> "I believe that, in general, publishers will welcome the deeper level of clarification represented in the [math] criteria. Much of the document sells the overarching pedagogy of focus, coherence, and rigor, which, for most publishers, is like preaching to the choir."
>
> CHARLENE F. GAYNOR
>
> Chief Executive Officer, Association of Educational Publishers

Diana L. Kasbaum, a math consultant at the Wisconsin education department and the president of the Association of State Supervisors of Mathematics, agreed: "I think it's very good. ... It's exactly what we need to move forward."

Linda Gojak, the president of the National Council of Teachers of Mathematics, said the document aligns "very nicely" with the standards and offers helpful guidance, such as the emphasis on ensuring coher-

ence in materials across grade levels to build knowledge over time.

However, Ms. Gojak said she was disappointed that the NCTM and other math groups were not invited to provide input before the document was published.

That point about broader input was made more bluntly by Robert C. Calfee, a professor emeritus at Stanford University's school of education.

"The process really bothers me; no public input into any of this, no indication that they consulted extensively with publishers, and just a document that has come down from Mount Sinai, at times almost arrogantly so," said Mr. Calfee, the vice chairman of a California standards commission in the 1990s.

Jason Zimba, a co-author of the criteria and one of the lead writers of the common-core math standards, said the document will be revised early next year to reflect input from across the field.

"We do expect NCTM and others to provide feedback on the substance of the document," he said.

Criteria for high school math are also expected to be issued early next year.

'Fixing the Market'

Called publishers' criteria, the document also explicitly seeks to guide states and districts in evaluating and selecting curricular materials or revising existing ones.

"These criteria were developed from the perspective that publishers and purchasers are equally responsible for fixing the materials market," the document proclaims. "Publishers cannot invest in quality if the market doesn't demand it of them nor reward them for producing it."

To that end, one endorsing group, the Washington-based Council of the Great City Schools, recently signaled that more than 30 of its member districts—including Chicago, Los Angeles, and New York City—would use the criteria in math and ELA to guide their decisions in selecting materials.

The goal of the criteria, the document cautions, is not to dictate acceptable forms of instructional resources. Instead, it says that "materials and tools of very different forms" can be deemed acceptable, including digital and online media.

The document speaks at length about the need for focus, coherence, and rigor in materials aligned to the common core, and wades into specifics that may raise eyebrows, such as the proposed 200-page limit for elementary math books.

Ms. Gojak of the NCTM, a former elementary teacher, argues that the limit will help teachers meet the goal of increased focus. "If you were to line up the traditional elementary math books over the last 15 years, they have grown thicker and thicker."

For middle and high school, the document says page lengths should not exceed 500 pages.

But Ms. Gaynor from the publishers' association questioned the value of limiting page counts. "I don't think good curriculum is driven by that kind of directive."

In addition, the criteria say that at any given grade level, approximately three-fourths of instructional time should be devoted to the "major work" of that grade. To illustrate, at the K-5 level, the "major work" generally consists of arithmetic and the aspects of measurement that support it, Mr. Zimba explained.

The document also spells out when it is appropriate for certain topics to be assessed in textbooks, such as through chapter or unit tests. Probability should not be assessed until grade 7, for instance, the document says, and statistical distributions until grade 6. That timing, it notes, is pegged to when those topics are first introduced in the common core.

Mr. Zimba said wading into the particulars of curricular decisions rather than being overly vague was a deliberate strategy.

"Some of these specifics are going to attract comment," said Mr. Zimba, a co-founder of Student Achievement Partners, a New York City-based nonprofit working with states and districts on common-core implementation. "But if we weasel out of limits and spe-

FROM STANDARDS TO CLASSROOM

The "publishers' criteria" issued for the common core in math offer guidelines for K-8 instructional materials that align to the standards.

FOCUS:
"Focus requires that we significantly narrow the scope of content in each grade so that students more deeply experience that which remains. ... Failing to meet any single focus criterion is enough to show that the materials in question are not aligned to the standards."

COHERENCE:
"Materials cannot match the contours of the standards by approaching each individual content standard as a separate event. Nor can materials align to the standards by approaching each individual grade as a separate event."

RIGOR:
"Educators will need to pursue, with equal intensity, three aspects of rigor in the major work of each grade: conceptual understanding, procedural skill and fluency, and applications."

TIME ON 'MAJOR WORK':
"In any single grade, students and teachers using the materials as designed spend the large majority of their time, approximately three-quarters, on the major work of each grade."

GRADE-LEVEL WORK:
"Differentiation is sometimes necessary, but materials often manage unfinished learning from earlier grades inside grade-level work, rather than setting aside grade-level work to reteach earlier content."

MATH PRACTICES:
"Over the course of any given year, ... each mathematical practice standard is meaningfully present in the form of activities or problems that stimulate students to develop the habits of mind described in the practice standards."

SPECIALIZED LANGUAGE:
"The language of argument, problem solving, and mathematical explanations are taught rather than assumed."

PROBLEMS WITH PURPOSE:
"Each problem or exercise has a purpose—whether to teach new knowledge, bring misconceptions to the surface, build skill or fluency, engage the student in one or several mathematical practices, or simply present the student with a fun puzzle."

VISUAL DESIGN:
"The visual design isn't distracting or chaotic, ... but instead serves only to support young students in engaging thoughtfully with the subject."

TEXT LENGTH:
"A textbook that is focused is short. ... Elementary textbooks should be less than 200 pages, middle and secondary less than 500 pages."

SOURCE: "K-8 Publishers' Criteria for the Common Core State Standards for Mathematics"

cifics, then we're actually not pushing things forward."

The other two co-authors of the criteria (and lead writers of the math standards) are William McCallum, a math professor at the University of Arizona, and Philip Daro, an education consultant who is working on a common-core project for the Pearson Foundation. Mr. McCallum and Mr. Daro also are advisers to Student Achievement Partners.

Carrie Heath Phillips, a program director at the Council of Chief State School Officers, in Washington, said the criteria will be a vital resource. "We've heard loud and clear, especially from district-level curriculum specialists or supervisors, that they need that guidance," she said.

Need for Coherence

On the issue of "coherence," the criteria make clear that this is not simply across topics but across grade levels. "Materials cannot match the contours of the standards by approaching each individual content standard as a separate event," the document says. "Nor can materials align to the standards by approaching each individual grade as a separate event."

Also, the criteria emphasize three aspects of rigor at each grade level: conceptual understanding, procedural skill and fluency, and applications. "To date, curricula have not always been balanced in their approach to these," it says.

W. Gary Martin, a professor of math education at Auburn University in Auburn, Ala., gives the document high marks for "hitting the right notes," though he raised a few concerns, including treatment of the eight standards for mathematical practice, which range from making sense of problems to constructing viable arguments.

"My biggest surprise was that the math practices were as buried as they were," he said, noting that they are not dealt with in any depth until more than halfway through the document. "To me, that is a central issue with textbooks. That's where textbooks are not even in the ballpark."

Peggy Brookins, a high school math teacher in Ocala, Fla., who served on an American Federation of Teachers team that provided feedback on the common math standards, said she's pleased by the document.

"They captured a lot of what teachers were thinking," she said. "The big part of the standards that it talks about that I like the most is having problems worth doing."

Ze'ev Wurman, a former education official in the George W. Bush administration who has been an outspoken critic of the standards, said the document "represents a reasonable effort to translate the standards into textbook criteria."

But he had several concerns, including the absence of language stipulating that instructional materials should have indices and glossaries and should support "self study" by students.

"Some popular current textbooks ... do not support self-study and some do not even contain an index or glossary," he said in an email. "Such textbooks make teachers the sole gatekeepers to content and create extra difficulties for transfer students or students absent due to illness."

Question of Affordability

A variety of observers say it's hard to know how influential the criteria will prove to be.

"How are the publishers really going to use this?" said Auburn's Mr. Martin. "Are they actually going to redo their materials in light of this, or simply retrofit a bit?"

Brad Findell, the associate director of math teacher education at Ohio State University, in Columbus, said publishers may balk at some criteria because of the cost.

"[Some] misinterpretations are going to be business decisions," he said. Publishers will say, "We can't do that. That's going to cost us $450,000," Mr. Findell said.

At the same time, the criteria document says it's not just publishers who need to respond, but also those who select textbooks.

"As a publisher, we respond to market demands," said Stewart Wood, Pearson's editorial chief for mathematics.

Mr. Wood called the criteria a "positive step," but said there's more to come that will shape the materials market.

"I expect a series of events that will change expectations of common-core materials: these criteria, their final version in early 2013, assessment items released in the spring of 2013, actual tests released in 2014," he said. "Each of these events will place new demands on common-core materials."

Coverage of the implementation of the Common Core State Standards and the common assessments is supported in part by a grant from the GE Foundation, at www.ge.com/foundation.

Published September 26, 2012 in Education Week

Math Common Core Spurs Utah Educators to Compose E-Texts

By Erik W. Robelen

Concerned about what they see as a dearth of instructional materials aligned with the Common Core State Standards in math, several educators in Utah, with support from the state office of education, are taking matters into their own hands. They're in the early stages of developing a set of e-textbooks for high school math that will be freely available.

In fact, two-thirds of the first e-book, for 9th graders, is already online for schools to use, with the rest expected later this fall.

"There was not a textbook out there that we felt reflected the common core," said Janet M. Sutorius, a math teacher at Juab High School in Nephi, Utah, who is a co-author. "We felt like the textbook companies were just reorganizing the chapters of their old books."

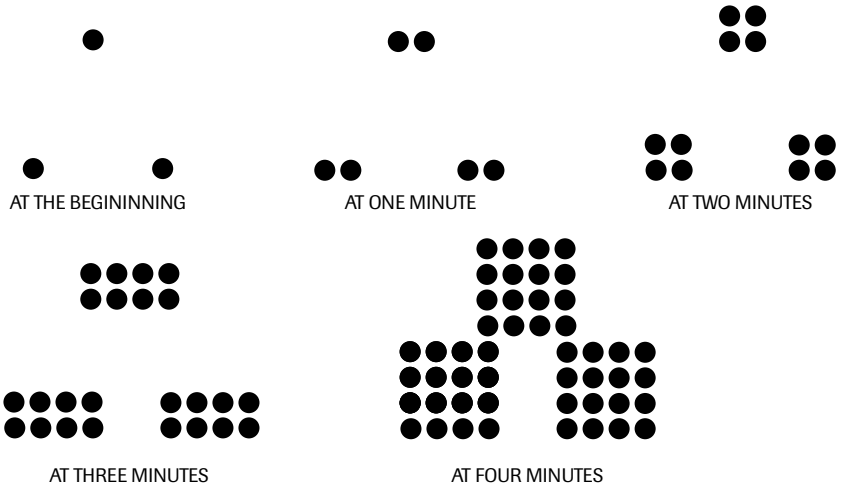
She added: "We wanted to teach our students in a different way, to make sense of the mathematics and make connections."

Finding strong materials has been especially challenging, those developing the e-textbooks say, because Utah has adopted a statewide policy of using an "integrated" model of high school math under the common core, dispensing with the traditional Algebra 1-Geometry-Algebra 2 pathway in favor of blending math subjects in each course.

So, Utah public schools are grappling not only with new standards, but also a reconfigured set of courses the state calls Secondary Mathematics I, II, and III. (In some Utah districts, 9th grade is taught in junior high school.)

Classroom Tasks

A set of mathematics e-textbooks being developed to align with the Common Core State Standards for high school bring a task-based approach, as seen in this example from a unit on arithmetic and geometric sequences.



1. Describe and annotate the pattern of change you see in the above sequence of figures.
2. Assuming the sequence continues in the same way, how many dots are there at 5 minutes?
3. Write a recursive formula to describe how many dots there will be after *t* minutes.
4. Write an explicit formula to describe how many dots there will be after *t* minutes.

SOURCE: Mathematics Vision Project

A Task-Based Approach

Ms. Sutorius is joined on the writing team by another classroom teacher, two academic officials in the Salt Lake City district, and a professor of math education at Brigham Young University.

The authors describe the enterprise, dubbed the Mathematics Vision Project, as embracing a "task-based" approach to fostering math proficiency that is closely aligned with the common-core standards.

Diana Suddreth, the STEM director for Utah's state education agency, said she sees great promise in the project, which the au- financial and other assistance.

The need is urgent, she said, given that Utah is now implementing the math standards.

"To leave teachers without any resources is something we can't do," Ms. Suddreth said. "[They're] writing what we hope to be a coherent and rigorous and focused set of textbooks."

It's up to districts to decide whether or not they want to use the materials. Ms. Suddreth notes that about one-quarter of Utah's 41 school systems have reported using the first e-textbook so far.

The math project is part of a broader push in Utah to promote greater use of online, "open source" materials that meet the needs of Utah educators and help districts save announced plans to help produce and support open textbooks in several areas, including high school math, English/language arts, and science, expanding on an earlier pilot project. The state office will encourage districts and schools statewide to consider using the textbooks.

A separate, state-supported effort with the University of Utah, meanwhile, is crafting e-textbooks for middle school math.

With Utah now pursuing an integrated approach to high school math under the common core, Ms. Suddreth said it's been difficult to find appropriate materials.

"The publishers were giving us what I call these crazy-quilt textbooks," she said.

Jay Diskey, the executive director of the

Association of American Publishers' schools division, said the industry is working hard to deliver aligned materials.

"Publishers large and small are doing everything they can to meet the market need that the common core presents," he said. "In some cases, that means creating whole new things, in others it may mean looking at what they have and making significant adjustments."

He added: "If a group of Utah educators says, 'We didn't see the sort of things that we need,' I certainly take them at their word, but perhaps they didn't look as far and wide as they should have."

Although the common-core math standards are organized by grade level in grades K-8, at high school, they are organized by conceptual categories, such as algebra and geometry. An appendix added later to the standards documents outlines four model pathways for states to consider, including a "traditional" approach consisting of two algebra courses and geometry (with some data, probability, and statistics included in each). Another approach suggested, and common in other countries, is an "integrated" sequence of math courses, each of which blends material across math-content areas.

Integrated Math

Utah and West Virginia appear to be the only states that have adopted as statewide policy the integrated approach, state officials and experts say, though in many places there is no state policy so districts may use an integrated model.

A statewide task force in Utah decided on the integrated approach after examining the issue carefully, Ms. Suddreth said.

"When you think about mathematics and how people use it, we use it in an integrated way," she said. "We don't think, 'Now I'm going to do some algebra, or now I'm going to do some geometry.' "

Ms. Suddreth concedes that the e-textbooks being designed by the Mathematics Vision Project may be seen as unorthodox.

"Everybody kind of has a picture in their mind of what a textbook is: some explanatory text, some problems, and homework," Ms. Suddreth said. "We've replaced the explanatory text with math tasks. ... The book is really a guide to help teachers take students through learning experiences."

The teacher's edition does include explanatory text for each task, helping teachers understand the task's goal and the particular standards addressed, and suggesting whole-class and small-group activities. The student edition has homework assignments for each task.

The authors say there's plenty of places students may go online for explanations of particular concepts.

In an introduction, the authors explain their approach, saying it is "neither purely constructivist nor purely traditional." The materials aim to get students engaged in problem-solving, guided by teachers, to promote math proficiency. Each unit, they write, has been designed and sequenced with "rich" tasks that develop concepts in the standards, with careful attention to the way math knowledge emerges.

Also, there will be regular and "honors" versions of each book.

"We wanted materials that were task-based so that students were ... engaged in the practices and making sense of the mathematics for themselves," said Barbara B. Kuehl, a co-author and the director of academic services for the 24,000-student Salt Lake City district.

Ms. Sutorius from Juab High School said one challenge has been to generate the materials rapidly.

"We're just running barely faster than [districts] are," she said. "We work full time, so we're working evenings and weekends, but there was just such a desperate need for the textbook."

An Impressive List

William G. McCallum, a math professor at the University of Arizona who was a lead author of the common math standards, said he was not prepared to comment on the content of the e-textbooks being developed, but that he's encouraged to hear of such projects.

"Anything that is trying a different way of writing textbooks is a good idea," he said, so long as the materials are well-designed and adhere to the standards. He said he was especially encouraged that the effort appears aimed at tailoring materials to the state's needs.

"There is a temptation to recycle old material and arrange it in different ways," he said.

Mr. Diskey from the publishers' group said he has no objection to educators creating their own e-textbooks, but he cautioned that it's not easy work.

"Developing a core instructional program, particularly one that meets the needs of all types of learners, is a very difficult task," he said. "There is scope and sequence, standards alignment, research, editorial development. All of these things come into play."

Ms. Sutorius acknowledged that the e-textbooks may not have universal appeal: "Not everyone is going to like it."

She added: "There are lessons I've struggled through, and they need to be improved." But as an e-book, she notes, it's easy to revise.

Brigham Young University plans to conduct research on the project, tackling such questions as whether the tasks are accessible to students and spark the intended student discourse. Later research will try to gauge the effect of the curriculum on student achievement.

Travis L. Lemon, another co-author and a math teacher at American Fork Junior High School, in North American Fork, Utah, said he's pleased with his classroom experience using the material so far.

"The students have a lot of opportunity to problem-solve, make sense of problems, listen to other students' reasoning, and refine their own thinking," he said, "and we solidify those understandings."

But student reaction varies.

"Some students respond much better than others," he said. "If they've been encouraged in the past to persist and dig in and make sense of things, they're more willing and apt to do that now. The ones that aren't, it's a little more challenging."

The first e-textbook is being used by 9th graders in the 7,300-student Uintah district in Vernal, Utah, said Keith D. McMullin, a math instructional coach for the system.

"It's been very positive," he said of the district's experience so far with the material, especially after teachers attended a workshop with two of the authors. "I was excited, and all the teachers that were there were excited."

He commended the teacher's edition for its thoroughness in guiding instruction, and said that, overall, the emphasis on tasks in the e-textbook brings the math to life for students and covers a lot of concepts.

"If you look at the tasks that are in there and really list all the things you can teach, ... it's a very impressive list," he said. "You're always building on what students learn the day before."

Coverage of the implementation of the Common Core State Standards and the common assessments is supported in part by a grant from the GE Foundation, at www.ge.com/foundation.

dreambox® LEARNING

CASE STUDY

CLARKSTOWN, NY

Transition to Common Core

Bridging the gap between current standards and the Common Core

CLARKSTOWN CENTRAL SCHOOL DISTRICT FAST FACTS

- Largest public school district in Rockland County, NY
- Graduation rate of 93%, well above state average
- 11 elementary schools
- 6.6% eligible for free or reduced-price lunch
- 2.5% English Language Learners
- 12.1% special education

DREAMBOX IMPLEMENTATION

- Deployed since 2010
- 11 elementary schools
- K–5 classrooms
- 3,700 students

FUNDING SOURCE

- District software budget

ABOUT DREAMBOX LEARNING

DreamBox Learning's Intelligent Adaptive Learning™ program accelerates learning by ensuring every student works continually in their optimal learning zone and helps all students achieve math proficiency.

Intelligent Adaptive Learning™

→ CHALLENGE:

Supporting greater focus, coherence, and rigor in mathematics instruction

As Clarkstown Central School District in Rockland County, New York, began the transition to the Common Core State Standards, they searched for a supplemental math program that would support the shift to greater focus, coherence, and rigor in mathematics. The district was looking for something that would help students who needed more support. Recognizing that some students were struggling with math concepts in intermediate and middle school, Clarkstown Central School District decided to prioritize early intervention in the primary grades. Principal Lisa Maher notes, "The gap only widens the longer you wait. We needed a strong, visually-based online program to build the foundational conceptual understanding of core content that is closely aligned to the Common Core."

→ SOLUTION:

Provide a visual model to develop conceptual understanding

A team of Clarkstown teachers across 11 elementary schools investigated many supplemental math programs, but found most of them inadequate for the district's needs. "The vast majority of programs out there just took a standardized test and converted it to digital form. That's fine for test prep—but not fine for helping with teaching the developmental concepts of math," said Dr. Marianne Strayton, a classroom teacher who was on the district committee. "DreamBox stood out for its use of representations and visual models that support how students learn and acquire understanding of mathematics."

> **"DreamBox stood out for its use of representations and visual models that support how students learn and acquire understanding of mathematics."**
>
> —Dr. Marianne Strayton, Teacher, Clarkstown Central School District

Another teacher on the committee, Wendy Ansons, agrees. "DreamBox has the best visual models for conceptualizing math I've seen. We have been impressed at how tightly aligned DreamBox was with the Common Core,

"DreamBox has the best visual models for conceptualizing math I've seen. We have been impressed at how tightly aligned DreamBox was with the Common Core, the quality of instruction, and the expertise of the DreamBox academic advisors."

—Wendy Ansons, Teacher, Clarkstown Central School District

the quality of instruction, and the expertise of the DreamBox academic advisors."

→ IMPLEMENTATION

Flexibility to fit every classroom's culture

Clarkstown's teachers have particularly appreciated DreamBox's online nature, which has allowed for variety in its implementation.

Students use DreamBox in computer labs on a weekly rotation, during center time within their classrooms, and at home. Wendy Ansons, a kindergarten teacher in the district, sees DreamBox as a way to build a stronger home-to-school connection and to reinforce skill building. "Technology is a great connection between school and home. Since DreamBox is online, students can learn anytime from anywhere, and teachers have access to the information on student progress," said Ansons. Some teachers who are looking to increase students' time on individualized areas of need use DreamBox as a homework option, especially during weeks where computer lab time is limited.

Clarkstown teachers also use the DreamBox Interactive Whiteboard Lessons, from the Dreambox Teacher Tools, as an introduction to a classroom lesson. This helps connect the students' individual experiences with the classroom learning. Mrs. Ansons' students love the 10 frame flash game, which they use as a warm-up.

DreamBox reporting has become a very useful tool for teachers. The reports can be used diagnostically, to see why a particular student is not able to move forward in the curriculum, as well as during RTI meetings with parents and other staff. The reports can also be used to identify cohort groups of the same skill level that can work together during class time.

→ RESULTS

A hands-on introduction to the Common Core

In addition to the Mathematical Content Standards, the Common Core also provides Standards for Practice, a guideline on the ways students should engage in math across grade levels. They include abstract and qualitative reasoning, real-world modeling, use of appropriate tools, and others. DreamBox is tightly aligned with these concepts and that alignment has been evident in Clarkstown's usage of the system.

As principal Lisa Maher describes, "In workshops, our [Common Core] consultant will talk about quick images and modeling with linking cubes. Teachers will now say, 'Oh, I've seen that in DreamBox!' As teachers work more closely with the Common Core standards, they see the conceptual connections within the visuals and tasks used in DreamBox. Often when teachers are demonstrating these newer strategies in class, students say 'Oh! That's like in DreamBox!'"

The Content Standards are rigidly scaffolded from grade to grade. Because of DreamBox's alignment to the Common Core and its ability to assess individual concept understanding, Clarkstown started noticing gaps in student learning. DreamBox was integral in helping Clarkstown address those gaps. John Krouskoff, Technical Director for the district, notes "DreamBox meets each student where they are. Our teachers see DreamBox as a welcome addition to their toolbox."

"DreamBox meets each student where they are. Our teachers see DreamBox as a welcome addition to their toolbox."

—John Krouskoff, Technical Director, Clarkstown Central School District

For more information, contact DreamBox at **877.451.7845**, email **schools@dreambox.com**, or visit **dreambox.com**.

Published December 31, 2012, in Education Week Teacher

COMMENTARY

The Talking Cure: Teaching Mathematical Discourse

By Marsha Ratzel

What's on the horizon for my young learners? I can't predict the future, but I know this much is true: Performing basic computational tasks won't be a gateway to a well-paid or long-term career. My students will need to be adept at locating information, analyzing it, and synthesizing it into something useful. They will have to be able to think, reason, and communicate to solve complex challenges.

This has big implications for how we teach math.

The Common Core State Standards, of course, highlight the importance of "mathematical practices." The idea is that if you can't talk about or explain the math you're doing, you don't know it well enough.

Middle school students are fairly accustomed to making educated guesses and talking in science class about how something works or will turn out. But it isn't something they are used to doing in math class. I realized that my middle schoolers needed to start discussing their math ideas in a logical way: forming conjectures, then using evidence and logic to "prove" their ideas. So I set out to get them talking.

Defining the Goal of Mathematical Discourse

My students had never heard of "mathematical discourse," so first we had to define it. Being typical middle school students, they liked the idea of arguing, but needed to learn the difference between arguing and discourse.

We started from the premise that a "conjecture is a statement for which someone thinks that there is evidence that the statement is true. The main thing about a conjecture is that there is no proof." That is, there's no proof at the time, but mathematical thinkers can create a process by which we test and generate proof, learning that our conjectures are (or are not) accurate.

Kicking Off Conversation

I wasn't exactly sure how to accomplish this kind of conversation, so I went to my Twitterverse friends and colleagues. Many math teachers I follow seem to be encouraging mathematical discourse effectively. I feel lucky to be able to read about how other educators have done this with their students before trying it with my own.

My students first worked on this kind of thinking/reasoning when I adapted an activity created by Malcolm Swan and shared by my Twitter friend Fawn Nguyen. I presented students with 20 equations that they had to classify as being Always, Sometimes, or Never true. The results were mediocre the first time, but as we tried versions of this activity again and again to work on different kinds of problems, students got better and better.

What's especially amazing: Students liked this approach and asked that we do something similar again. And let me tell you, when 8th graders ask to do an assignment again, it's a real victory!

These initial experiences helped students as we tackled lessons about linear and nonlinear equations and models. We worked on different versions of Dan Meyer's 3-Act Math Tasks, including Split Time and Leaky Faucet. In each case, students considered the information at the beginning of the problem, offered a conjecture, figured out what else they needed to know, and set about testing their ideas. They compared notes with each other to identify what was—and wasn't—working.

Where We Are Today

We're nearing the end of the first semester of the school year, and lately I've been noticing that students are approaching problems in more systematic ways.

In a recent series of lessons, we were studying functions and trying to figure out what the domain of a function might be.

Mind you, most of my students are still trying to amp up their number sense. Thinking about functions requires students to have a working knowledge of how numbers are strung along the number line and why numbers fall into different categories. This goes well beyond identifying and understanding odds, evens, composite, or prime numbers—I ask students to build on that knowledge but to consider bigger sets/categories.

For example, students had to decide if you could divide by zero. I asked them what kinds of numbers have square roots—do positive numbers, negative numbers, fractions? And what about zero? Students couldn't find a domain if they didn't have a grasp of those kinds of number sense questions.

After further developing their number sense, students began building conjectures. It's critical for students to have the opportunity to exchange ideas and figure out how to test them, working alongside classmates. I stood nearby, occasionally offering questions or encouragement—more like a sports coach than a traditional lecturing math teacher. If you're anything like me, you may find it tough not to jump into the conversations, but it's so exciting to hear students stretching their thinking!

I had the delight of watching students work and work on finding the domain of a function, figuring out whether a table was a function, and similar problems. Calculators in hand, they'd test out a bunch of ideas, then check in with other groups to compare notes. They'd be excited and hopeful about an initial answer … only to have that idea go, "POP!" Then they'd regroup and try another approach.

They didn't give up. With time, they pieced together a common understanding. And they drew upon the language and concepts we'd been building, lesson by lesson, throughout the semester.

Discourse as Classroom Culture

For homework one night, students answered this question: "What is the set of routines that defines how you approach

testing your ideas?" They shared their responses with partners in class the next day, and then the class collaborated to identify a common working process. Students defined a set of steps they felt were handy for sizing up a problem, logically working through possibilities, and (after the testing) crafting a general statement.

This is abstract stuff. Open-ended educational experiences can be tough for students (especially if they haven't learned this way before), and I see how they struggle to hang in there. But when I continuously build this kind of thinking into daily lessons, I see students becoming more confident.

Here's my status report, midway through the school year: In a class of about 30 students, I'd wager that at least half look forward to tackling open-ended questions. About a quarter are enjoying the experience and can function well within groups, but struggle with individual work. And a quarter are frustrated—they just want the right answer.

What does this mean for me as a teacher? I provide additional support, prompting, and encouragement to students who don't feel comfortable with offering their guesses about math ideas. It's a delicate balance; I don't want to do the work for them, but they sometimes need specific direction to keep them from giving up.

Reflecting on where we are and how far we've come this semester, I see great progress. Progress that I'm not sure we'd have accomplished without incorporating mathematical discourse and conjecturing.

Sometimes I think it's the actual math skills where I see the most build-up of students' proficiency. Other times, I believe where they've made the most progress is in the act of talking math with each other.

When I observe my students, I see future architects, engineers, accountants and computer app developers gaining critical skills in analyzing, creating ideas, testing them out, and then defending them. I also witness students taking risks and supporting each other in being mathematical thinkers.

And as these kinds of assignments become routine, I see our classroom culture shifting. My classroom is becoming more like the collaborative, challenging work environments my students will face in the future—whether or not their careers have anything to do with math.

Marsha Ratzel is a National Board-certified teacher in the Blue Valley School District in Kansas, where she teaches middle school math and science. A member of the Teacher Leaders Network, she writes often about her teaching practice at Reflections of a Techie.

Published October 3, 2012, in Education Week

COMMENTARY

Engineering Good Math Tests

By Hugh Burkhardt

Narrow math tests inevitably drive down real standards because accountability pressures principals and teachers to teach to the test. Conversely, well-engineered tests of the math we actually want people to study and learn raise standards. It may not surprise you that high-performing countries such as Singapore have better mathematics—as defined in the Common Core State Standards—on their tests than the United States does. More surprisingly, good tests are less expensive in real terms.

There are worrying signs that the actual common-core assessments will be too close to "business as usual," albeit computerized. If so, most U.S. students and future citizens will be condemned to further mediocrity in mathematics.

The need for better tests is accepted by business, industry, and government. In 2009, President Barack Obama called on "our nation's governors and state education chiefs to develop standards and assessments that don't simply measure whether students can fill in a bubble on a test, but whether they possess 21st-century skills like problem-solving and critical thinking, entrepreneurship, and creativity."

Since then, the states have led the development of common standards in mathematics that embody this broader vision, and two consortia of states, the Smarter Balanced Assessment Consortium, or SBAC, and the Partnership for Assessment of Readiness for College and Careers, or PARCC, have been funded to develop assessments aligned with the standards. Much progress has been made.

Everyone accepts that, when used as the linchpin of accountability, tests are not "just" measurement, but often direct the efforts of school employees and dominate what is taught in classrooms. The SBAC "content specification" for the common-core math assessment (which I helped write) features problem-solving and modeling with mathematics, reasoning, and critiques of reasoning, alongside the concepts and skills needed to make these possible.

Crucially, it also includes many examples of assessment tasks that show how these principles have been realized in math examinations in the United States and around the world. Examples are harder to misinterpret than descriptions. Teachers, students, and citizens understand that items on the tests represent the types of tasks students must learn to do.

The feedback to SBAC on this content specification has been overwhelmingly positive. So what is the problem?

A strong undertow of fear appears to be pulling the system back to the familiar. This is a test of our courage—a test our tests may fail.

There is growing concern that test implementation will be a third-rate realization of the common core—that the design and "engineering" will not be good enough. The problems seem to be caused by a mixture of fear and lack of experience and by a decision-making structure unsuitable for innovation. State assessment directors are fearful of cost and litigation if their well-oiled testing systems, already sometimes controversial, have to change. High-quality examinations that cover the common core and meet international standards are outside their experience and their zone of comfort.

In high-performing countries, mathematics-curriculum experts have final say on the problems and scoring of the examinations. Psychometricians are technical advisers. In the United States, the practice has been turned upside down: Psychometricians too often have the final say on the items in a test, while the mathematics experts play a secondary role. SBAC and PARCC continue this upside-down tradition that values technical measurement above accountability for teaching and learning the core mathematics in the standards.

What is the problem with current tests? Multiple-choice tests and their latest variant—computer-adaptive tests—measure with many very short items. The grain size of these items is much smaller than the basic concepts of mathematics. The items have a very indirect relationship to the targets of in-

struction: the math in the standards. In mathematical reasoning and problem-solving, the whole is more than the sum of the parts. This is recognized in English/language arts, where we assess substantial pieces of reading and writing.

To find out if students can do mathematics, we need to find how well they can create, critique, and explain substantial chains of reasoning. Multiple-choice tests cannot handle this, nor can their computer-based variants. When you look at the "technology-enhanced items" designed to assess "depth of knowledge," you find that potentially rich tasks have been broken into sequences of short items. This ignores the real target: chains of student reasoning that may take diverse paths and be expressed with words, sketch diagrams, and symbols in diverse ways. Mathematics is not treated as a coherent body of mathematical content and practices, but as fragments indirectly related to the target knowledge. This makes a test that defines the targets of instruction invalid.

It is easy to do better. You ask students to tackle tasks that represent the kinds of performance that you really want them to be able to do, not proxy tasks that are easy to assess. As with writing, you have them scored by trained human beings using specific rubrics for each task that award points for the core elements of performance. You audit the process to ensure reliable scoring. This is the way examinations are run in other advanced countries.

A well-made test matches the depth and balance of the learning targets. This involves selecting an appropriate balance of short items and substantial performance tasks so that teachers who teach to the test, as most teachers will, are led to deliver a balanced curriculum that reflects the standards. This needs a "mathematics board," a body whose members are experts in math education and mathematics. The consortia should establish such panels for task selection and test balancing.

Where will the tasks come from? Designing accessible assessment tasks that demand substantial chains of reasoning is a challenging area of educational design. Test vendors have little experience, and the skills do not come quickly. However, there is a large international literature of well-engineered tasks across this range that can be licensed for use in tests. (Disclosure: A project in which I am involved—the Mathematics Assessment Resource Service, or MARS—is one not-for-profit source.)

And what of cost? Vendors charge a dollar or two for traditional tests, and they only need a class period of testing time. People are rightly concerned at "wasting" teaching and learning time. Yet ask teachers how much time they spend on otherwise unproductive test preparation. Typical responses are that test prep for state tests takes 20 days a year. That's more than 10 percent of teachers' time and, worse, more than 10 percent of the students' learning time. This is the real cost of aiming at a cheap target.

Good tests cost a bit more than computer-based tests. How much depends on how you manage them. One inexpensive model is to make scoring training and actual scoring part of each teacher's job. This is high-quality professional development, showing teachers what is valued in math performance and what other students can do. If this takes two days a year, you are still well ahead on the test-prep clock, with many more days for real teaching and learning than with artificial tests.

What about test prep for good tests? With "tests worth teaching to," that is something you want. Test tasks are valuable learning experiences. The test itself is not a waste of learning time; it is instead exactly the task for which teaching prepares you.

Hugh Burkhardt has, since 1982, led a series of assessment projects with test providers in the United States and the United Kingdom who sought to align their mathematics tests with learning goals. He is based at the University of Nottingham's Shell Center in England, where he works with the Mathematics Assessment Project of the Mathematics Assessment Resource Service, and the University of California, Berkeley. He founded the International Society for Design and Development in Education and chairs the advisory board of its e-journal, Educational Designer.

Published July 18, 2012, in Education Week

COMMENTARY

Seizing the Moment for Mathematics

By William Schmidt

For years now it has been clear that the U.S. mathematics curriculum is a mile wide and an inch deep, and that the fragmented quality of mathematics instruction is related to our low ranking on international assessments. Nearly a generation after the first Trends in International Mathematics and Science Study, the nation's governors and chief state school officers, in concert with other stakeholders, have fashioned the Common Core State Standards for mathematics that may finally give American students the high-quality standards they deserve.

These new math standards have attracted some criticism, however. Aside from more abstract arguments, a number of specific claims have been leveled against them, including that they are untested; that they are not world-class; and that some existing state standards are superior.

As part of our ongoing research, Richard Houang and I recently concluded a study of the math standards and their relation to existing state standards and the standards of other nations. Drawing from our work on the 1995 TIMSS, we developed a measure of the congruence of the common core to all 50 state standards in effect in 2008-09, as well as to an international benchmark. We also examined the relationship of each state's math standards to the common standards and how each state performed on the 2009 National Assessment of Educational Progress. Although, we can't project the success of the common math standards with certainty, it would give us reason for optimism if states whose standards more closely resembled those of the common core performed better on NAEP.

What did our research uncover?

The common-core math standards closely mirror those of the world's highest-achieving nations. Based on the 1995 TIMSS, we identified common standards from the best-performing countries, which we call "A+ standards." We found an overlap of roughly 90 percent between the common math standards and the A+ standards. If the standards of the world's top achievers in 8th grade mathematics are any guide, then the common standards represent high-quality standards. Of course, as a nation, we shouldn't just slavishly replicate whatever we find other countries doing. But when we look across a number of very different countries—all of whose students do better than ours—we find the same curricular characteristics over and over again. The only sensible course of action is to take a close look and see if important lessons can be learned.

In doing this, we find three key characteristics in the curricula of the highest-performing countries: coherence (the logical structure that guides students from basic to more advanced material in a systematic way); focus (the push for mastery of a few key concepts at each grade rather than shallow repetition of the same material); and rigor (the level of difficulty at each grade level). The common core adheres to each of these three principles.

Unfortunately, when one hears that a state's existing standards are better than the common core, it usually means that those standards include more—and more advanced—topics at earlier grades. But this is exactly the problem the common math standards are designed to correct. It is a waste of time to expose children to content they are not prepared for, and it is counterproductive to skim over dozens of disconnected topics every year with no regard for student mastery. As it stands today, we simply hope that students will somehow "get it" at a later grade, and yet we know that far too many students never do. The disappointing reality is that, while improved from a decade ago, most state math standards fall below the common standards in both coherence and focus.

In debating the utility of the common core, it is very important to recognize that standards are not self-executing. For example, states with very strong standards but very low thresholds for "proficiency" on the state assessments are, in effect, sending a message to teachers and districts that their standards aren't to be taken that seriously. In that way, proficiency cut points can serve as a rough measure of implementation. After including both cut points and how far away a state's standards are from the common core (controlling for poverty and socioeconomic status), we found that the two in combination are related to higher mathematics achievement—an even stronger relationship than was the case when only the measure of similarity was included. In the final analysis, however, the key ingredient in the implementation of standards is whether districts, schools, and, most importantly, teachers, deliver the content to students in a way that is consistent with those standards.

> "As it stands in many classrooms, teachers are forced to pick and choose among the topics as laid out in the textbook, items on state assessments, and the content articulated in state and district standards—expressions of the curriculum that frequently clash with one another."

As it stands in many classrooms, teachers are forced to pick and choose among the top-

ics as laid out in the textbook, items on state assessments, and the content articulated in state and district standards—expressions of the curriculum that frequently clash with one another. In our recently completed Promoting Rigorous Outcomes in Mathematics and Science Education, or PROM/SE project—a research and development initiative to improve math and science teaching and learning at Michigan State University—we found tremendous variation in the topics covered in mathematics classes within states, within districts, and even within schools. In fact, the content coverage in low-income districts had more in common with the content delivered in low-income districts in other states than with that of the more affluent districts in their own states. Given how haphazardly standards are implemented, it shouldn't be much of a surprise if the relationship between state standards and student achievement is modest. What's remarkable is that the relationship is as strong as it is.

The essential question is not whether the common core can improve mathematics learning in the United States, but whether we, as a nation, have the commitment to ensure that it does. The adoption of the common core doesn't represent a success, but an opportunity. It remains to be seen whether the right kind of common assessments and supporting instructional materials will be developed. It is very much an open question whether states will devote the energy and planning required, especially in a time of fiscal constraint. And, most urgently, we don't yet know if teachers will receive the preparation and support they need to teach mathematics in a fundamentally new way.

Published by Editorial Projects in Education, Inc.
6935 Arlington Road, Suite 100
Bethesda, MD, 20814
Phone: (301) 280-3100
www.edweek.org

WEB LINKS

EDUCATION WEEK RESOURCES

Resources on Math and the Common Core

NOW FEATURING INTERACTIVE HYPERLINKS.
Just click and go.

Common Core State Standards in Mathematics
http://www.corestandards.org/Math

Curricular Coherence and the Common Core State Standards for Mathematics
http://edr.sagepub.com/content/41/8/294.full
Houang, R. T. and Schmidt, W. H.
Educational Researcher, November 2012, Vol. 41 No. 8

Illustrative Mathematics
http://www.illustrativemathematics.org/

K–8 Publishers' Criteria for the Common Core State Standards for Mathematics
http://www.corestandards.org/resources

Math Common Core Coalition
http://www.nctm.org/standards/mathcommoncore/

Math Practices and the Common Core: An *Education Week* Webinar
http://www.edweek.org/ew/marketplace/webinars/webinars.html
Education Week, July 26, 2012

Mathematics Vision Project (MVP)
http://www.mathematicsvisionproject.org/

Partnership for Assessment of Readiness for College and Careers
http://www.parcconline.org/

Promoting Rigorous Outcomes in Mathematics and Science Education (PROM/SE)
http://msustatewide.msu.edu/Programs/Details/1843

Revealing How Education Leaders Can Work Together on Common-Standards Implementation: An *Education Week* Webinar
http://www.edweek.org/ew/marketplace/webinars/webinars.html
Education Week, July 11, 2012

Smarter Balanced Assessment Consortium
http://www.smarterbalanced.org/

BACK TO TABLE OF CONTENTS