Patte Barth

The Power of Math

One of the best things we can do to prepare young people for a successful life is to give them a good—and early—start in math, research shows

Educators and parents have long known the importance of early literacy to preschoolers' later academic success. What they may not know is that their math skills are equally important.

A major study shows that young children's math abilities are far more predictive of their academic achievement throughout their school years than their social or emotional behaviors, neither of which, it turns outs, has much effect on later achievement. Math also has a slight edge on literacy in its long-term influence.

The research team, led by Northwestern University's Greg Duncan, analyzed six studies including data for more than 35,000 preschoolers. The team found that knowledge of numbers had the most impact on students' academic achievement through age 14, followed closely by early reading and language skills.

Math-related skills do not just predict later math performance, but reading achievement, too. Moreover, early mastery has a lasting impact. Duncan found that students who struggled with math in elementary school were less likely to graduate from high school and far less likely to attend college later on, by 13 and 29 percentage points, respectively.

Mathematical development in fact starts in infancy. Psychologists such as Alison Gopnik at the University of California, Berkeley, are showing that babies are natural statisticians who use data to make sense of the world. In one study, 2-year-olds were able to infer probabilities—for example, the likelihood a toy will light up—and revise predictions based on new information. Other studies have identified babies as young as 8 months showing a basic understanding of random sampling.

Math should be central

Despite the importance of early numeracy, the math conversation in education policy circles tends to focus on course-taking in high school. To date, 23 states and the District of Columbia have established graduation requirements that align with college- and career-readiness, including three to four years of math at least through Algebra II.

These policies enjoy wide public support, as well. According to a survey by Achieve, Inc., nearly nine in 10 voters support having college and career graduation requirements for all students.

There are good reasons for this support. A

BY THE NUMBERS

Before and After

Both items below test 5th graders' knowledge of how to write expressions, but demand different skills.

Before the Common Core:

There are a total of y students in Mr. Smith's classroom. Which of the following represents the number of students in the classroom when 3 students are absent?

A. y + 3
B. y - 3
C. y x 3
D. y ÷ 3

Virginia SOL released items, grade 5 math, 2010

After the Common Core:

Write an expression that records the calculations described below, but do not evaluate.

Add 2 and 4 and multiply the sum by 3. Next, add 5 to that product and then double the result.

Illustrative mathematics, retrieved April 16, 2012

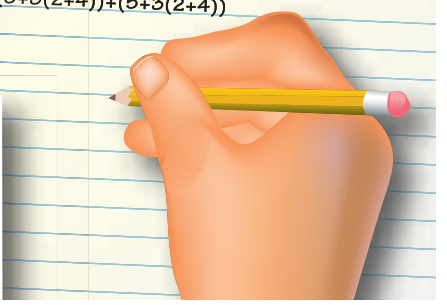
What's the difference?

The first requires one step to solve.

The second requires several steps to solve. It also has multiple correct responses as follows:

2(5+3(2+4))

or (5+3(2+4))2 or 2(3(2+4)+5) or (3(2+4)+5)2
or 2((2+4)3+5) or ((2+4)3+5)2
or (5+3(2+4))+(5+3(2+4))



SOURCE: Center for Public Education

Julie Ridge

large body of research—including studies from NSBA's Center for Public Education—points to high-level high school math as a strong predictor of success in college and the workplace—in addition to making better citizens as measured by voting, volunteering, and healthier lifestyles.

But we're also learning that attention to math skills can't start too early. If we're serious about improving all students' chances for success after graduation, we really need to grant mathematics a central spot in comprehensive education policies covering pre-k through high school students.

Common Core applications

The Common Core State Standards (CCSS) could be a good place to start. The CCSS are intended to be internationally competitive, and have college- and career-readiness in mathematics and English language arts as their ultimate goal.

Starting with that end in mind, the CCSS map backwards to establish grade-level benchmarks all the way down to kindergarten. This means that the math skills children learn in the earliest grades are designed to set them on the path toward success after high school.

The CCSS are now the standards of record in 46 states and the District of Columbia. But the widespread adoption of CCSS does not make them immune to debate. Some of the objections are political: Opinions vary over whether we even should have national standards, voluntary or otherwise. But the CCSS also have prompted some controversy about their educational content, particularly in math.

The CCSS differ from most state math standards in important ways. One, they define specific mathematical practices for students at all levels. These practices include the ability to make sense of problems and persevere in solving them; construct viable arguments using mathematics; reason abstractly and quantitatively; and use appropriate tools strategically.

The CCSS also place more emphasis on data, probability, and statistics than U.S. students typically receive, and it begins early. Kindergartners, for example, will be asked to classify objects such as organisms with wings and without wings, sort them, and compare the numbers. By third grade, students will be organizing and graphing their data to scale.

Throughout elementary school, there is also more attention to algebraic thinking so students will be ready for the demands of algebra in high school. And there are clearer expectations for learning fractions, a topic that U.S. students have struggled with for decades.

Common Core critics

Most of the criticism is aimed at the CCSS' treatment of high school math. Ze'eve Wurman, a high-tech industry executive and former official in the U.S. Department of Education, and Sandra Stotsky of the University of Arkansas reviewed the CCSS for the Pioneer Institute, a libertarian think tank.

In their view, the math standards are not on a par with those of high-achieving nations, mostly because Algebra 1 content was deferred to ninth grade. Looking through the lens of four-year college admissions offices, they also were concerned that the standards do not precisely follow the algebra-dominated college prep curriculum.

W. Stephen Wilson, a mathematician at Johns Hopkins University, picks up on this line of thinking. Regarding the CCSS emphasis on data, Wilson wrote that "statistics and probability [are] probably irrelevant for college preparation."

Their proponents, however, point out that the CCSS are intended to prepare students for a range of postsecondary options, including but not exclusively for four-year colleges.

The Educational Policy Improvement Center at the University of Oregon conducted a survey of higher education faculty who had reviewed the CCSS for how well they aligned to the skills needed to succeed in both general education and career-focused courses.

Unlike Wurman, Stotsky, and Wilson, the instructors—representing both two- and four-year institutions—found a great deal to admire, particularly in the standards for mathematical practices.

William Schmidt of Michigan State University is the leading expert on TIMSS—The International Math and Science Study of fourth- and eighth-graders—and was the first person to alert the U.S. on its problems with a math curriculum that is "a mile wide and an inch deep." He has found that CCSS math standards "closely mirror those of the world's highest-achieving nations." He especially commended the CCSS for being focused and bringing badly needed coherence to how our students will learn math.

The debate no doubt will continue and won't be settled until the CCSS have had a chance to be fully implemented. As educational consultants Jay McTighe and Grant Wiggins have written, "The standards come to life through the assessments." The two state consortia developing CCSS assessments have begun to release sample items (see sidebar for a math example) that tangibly show what students will be expected to know and do. Schmidt cautions: "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."

Obviously, school districts have a lot to do to prepare. Elementary teachers in particular have traditionally been less comfortable with math than with other subjects. They will need content-rich, ongoing professional development to learn the new math standards and engaging ways to teach them. And don't forget the little ones. Districts should reach out to the pre-k providers in their communities to align their math programs so that kindergartners are ready when they arrive. As research shows, one of the best things we can do to prepare young people for a successful life is give to them a good, early start in math. ■

Patte Barth (pbarth@nsba.org) is director of NSBA's Center for Public Education (www.centerforpubliceducation.org).