ISSUE BRIEF

Common Core State Standards: Mathematics

Sarah Perry

Common Core State Standards (CCSS) in math were developed to address the criticism that national math curriculums were "a mile wide and an inch deep."[1] The drafters sought to develop more focus and coherence through the standards, with the belief that those students who can explain mathematical rules would have a better chance at succeeding in less familiar mathematical tasks. The CCSS cover fewer topics than those covered by traditional math materials, and eliminate topics such as pre-calculus and most aspects of trigonometry. CCSS also eliminate concepts traditionally associated with algebra II and geometry, such as complex numbers, vectors, polynomials, logarithms, logarithmic and exponential functions, the Binomial Theorem, composite and inverse functions, matrices, ellipses, hyperbolae, the derivation of area of general triangles, and the concept of "pi."[2]

Trevor Packer, Senior Vice President at the College Board and in charge of its Advanced Placement (AP) program, speaking at the 2013 annual conference of School Superintendents Association (AASA), relatedly noted that the Common Core is less rigorous than what high schools routinely teach today and, consequently, the College Board is considering eliminating AP calculus. As the AASA noted: "In particular, AP Calculus is in conflict with the Common Core…and it lies outside the sequence of the Common Core because of the fear that it may unnecessarily rush students into advanced math classes for which they are not prepared. The College Board suggests a solution to the problem of AP Calculus 'If you're worried about AP Calculus and fidelity to the Common Core, we recommend AP Statistics and AP Computer Science,' [Packer] told conference attendees."[3]

- **Standards for mathematical domains in grades K-8 include:** (1) counting and cardinality, (2) operations and algebraic thinking, (3) number and operations in base ten, (4) fractions, (5) measurement and data, (6) geometry, (7) ratios, (8) expressions and equations, (9) functions, and (10) statistics and probability.
- **Standards for conceptual categories in grades 9-12 include:** (1) number and quantity, (2) algebra, (3) functions, (4) geometry, and (5) statistics and probability.
- **Standards for mathematical practice across all grades include:** (1) make sense of problems and persevere in solving them, (2) reason abstractly and quantitatively, (3) construct viable arguments and critique the reasoning of others, (4) model with mathematics, (5) use appropriate tools strategically, (6) attend to precision, (7) look for and make use of structure, and (8) look for and express regularity in repeated reasoning.

In 2012, President Obama proposed establishing an elite corps of teachers in science, technology, engineering, and math (STEM) through a $1 billion grant program. However, the CCSS for math fail to prepare students for STEM careers at home or abroad. Jason Zimba, the leading drafter of the Common Core Mathematics Standards, noted in 2010 that the basic

mission of CCSS is to provide students with enough mathematics to make them ready for a *non-selective* college—"not for STEM."[4] Zimba later explained in a 2013 article published by the Columbia University's Teachers College that, because CCSS math removes a number of mathematical concepts altogether, "[i]f you want to take calculus your freshman year in college, you will need to take more mathematics than is in the Common Core."[5] Already, over 20% of bachelor's degree holders in the U.S. who earned their college degrees in STEM fields are foreign born, with more than half of those students coming from Asia[6] and a more competitive math track. As CCSS Mathematics become the norm, that discrepancy seems unlikely to improve.

Jonathan Goodman, a professor of mathematics at New York University has stated that the "college-ready" standards of the CCSS fall below the admission requirements of most 4-year state colleges, and that the CCSS "[have] significantly lower expectations with respect to algebra and geometry than the published standards of other countries."[7] Illustratively, the CCSS defer the teaching of algebra from 8th grade to high school, thereby reversing the 2008 recommendations of the National Mathematics Advisory Panel, and putting the U.S. one to two years behind the math practices of higher performing nations. The standards also make puzzling omissions of geometry basics, instead relying on an experimental approach that uses the basis of rigid motions and is internationally untested.[8] All this follows on the heels of a dogmatic opposition to teaching computation skills until the later elementary grades. William Schmidt of Michigan State, has found that "internationally, the focus of eighth grade for all students in virtually all of the TIMSS [Trends in International Mathematics and Science Study] countries—except the United States—is algebra and geometry."[9]

The materials cited by the CCSS refer to the composite standards of Hong Kong, Korea, and Singapore, which place more emphasis in early math education on geometry and measurement than U.S. curriculums. Yet the CCSS represent a movement from the concrete to the abstract, and have been criticized by many as producing a nation of "little mathematicians" who don't actually have the tools they need to solve math problems.[10]

The standards require students to explain *why* a particular procedure works.[11] No longer will a student be able to simply divide one fraction by another, based on fundamental facts and formulas memorized in previous grades. He or she must also use the relationship between multiplication to explain that (2/3) ÷ (3/4) = 8/9, because 3/4 of 8/9 is 2/3.[12] First grade students do not have to memorize equations or calculations, but now they must be able to understand and demonstrate the use of the associative property of addition. For example: 2 + 4 + 6 = 12 becomes 2 + 4 + 6 = 2 + 10 = 12.[13] Previously, this idea was not introduced until 2nd grade. First graders must also be able to demonstrate the "decomposition" of two-digit numbers leading to a ten in the effort to demonstrate place value. No longer is 13 – 4 = 9 a sufficient calculation. Instead, a student must explain that: 13 - 4 = 13 – 3 – 1 = 10 – 1 = 9.[14]

The CCSS sacrifice efficiency, logic, and competency for explanatory rhetoric, with actual math computations (such as adding and subtracting double and triple digit numbers) delayed from 2nd grade, until 4th grade. Standard methods of multiplication and long division also evince the CCSS's tendency toward delays in comprehension, as they are delayed until 5th and 6th grade. Students in Singapore, Japan, Korea and Hong Kong achieve fluency in fractions and decimals

in 5th grade, but while the drafters of the CCSS touted fractions as the Common Core's greatest strength, they are actually delayed until 6th grade.

Higher performing Asian countries are actually *doing* math well before their U.S. counterpart. Consider, for example, a 2011 study entitled "Common Core Standards: The New U.S. Intended Curriculum," which revealed that countries seen as having the most literate students in mathematics, such as Finland, Japan, and Singapore, focused roughly 75% of their content on "Perform[ing] Procedures."[15] Students in these nations focused on reading graphs, using tables, and making measurements, among others.[16] By comparison, the CCSS dedicate only 38% of their content to "Perform[ing] Procedures."[17]

At the same time, CCSS require young students to make sophisticated leaps in reasoning which are generally very difficult in the primary grades. From New York, one of the first states to implement Common Core and give Core-aligned standardized tests, come test questions for first graders (children 5 and 6 years old) such as: "Which is a related subtraction sentence?" from a multiple choice list of four *addition* sentences.[18] New York Education Commissioner John King has testified that the Common Core standards were "back mapped" from a description of 12th grade college-ready skills. However, as Carol Burris, an acclaimed New York high school principal, states, "There is no evidence that early childhood experts were consulted to ensure that the standards were appropriate for young learners. Every parent knows that their kids do not develop according to a "back map"—young children develop through a complex interaction of biology and experience that is unique to the child and which cannot be rushed."[19,20]

While the standards were internationally benchmarked against high-performing Organization of Economic Cooperation and Development (OEDC) countries,[21] the age at which students begin school varies from nation to nation: In the U.S., students begin Grade 1 at the age of 5 or 6; in Finland, students begin Grade 1 at age 7; in Singapore, students begin Grade 1 at age 7 after two years of kindergarten. The CCSS developers and sponsors have failed to make an adequate argument that U.S. students are somehow globally "behind" when the nations upon whose curriculum the CCSS are based begin education two years later than U.S. students.

The Education Policy Center at Michigan State University reports that 60%-70% of current math texts contain more material than the CCSS call for.[22] While proponents claim non CCSS-compliant texts could discourage more focused, sophisticated instruction in math, the shift is an example of the dichotomous "dumbing down" required of math students through the CCSS. — The standards require both highly-ordered explanations and a conflicting delay of concrete solutions, but also totally eliminate more advanced topics altogether.[23]

Standards for mathematical practice—those that conclude the CCSS math materials—are reasonable and logical in and of themselves, but also present habits that should develop naturally as students continue in and enjoy their practice of math. Instead, the CCSS indicate that the "points of intersection" between Standards for math content and Standards for math practice ought to be weighted toward central concepts that merit the most time, resources, and focus. In essence, CCSS require students to practice the skills that require the most "practice."

Sarah Perry is an attorney with a degree from the University of Virginia School of Law, where she was on the editorial board of the Virginia Journal of International Law. *After six years in private practice where she focused on business litigation, commercial document drafting, and business development, Sarah took on an adjunct professorship, teaching Business Ethics at the Community College of Baltimore County. After the birth of her first child, she transitioned full time to writing. She currently serves as the Common Core Coalition Manager for the Family Research Council.*

---

[1] "Mathematics Standards," Common Core State Standards Initiative, accessed on April 10, 2014, http://www.corestandards.org/Math/.
[2] Ze`ev Wurman and W. Stephen Wilson, "The Common Core Math Standards," *Educationnext*, 12(3) (2012): 44-50, accessed April 10, 2014, http://educationnext.org/files/ednext_20123_Forum.pdf.
[3] Keren Yi, "College Board: Reconciling AP Exams With Common Core," AASA, accessed April 17, 2014, http://www.aasa.org/content.aspx?id=27296
[4] Sandra Stotsky, "Common Core Doesn't Add Up to STEM Success," *The Wall Street Journal*, January 2, 2014, accessed on April 10, 2014, http://online.wsj.com/news/articles/SB10001424052702304020704579278060483138096.
[5] Sarah Garland, "The Math Standards: Content and Controversy," *The Hechinger Report*, October 15, 2013, accessed on April 10, 2014, http://hechingerreport.org/content/the-math-standards-content-and-controversy_13325/.
[6] Michael Wildes, "Asian arrival: How STEM demand led to a massive shift in immigration," *The Washington Post*, updated on June 22, 2014, accessed on April 10, 2014, http://www.washingtonpost.com/business/on-small-business/asian-arrival-how-stem-demand-led-to-a-massive-shift-in-immigration/2012/06/21/gJQAaShLtV_story.html.
[7] Wurman and Wilson, "The Common Core Math Standards."
[8] Ibid.
[9] The Hechinger Report, "The Common Core Math Standards: Content and Controversy," *U.S. News & World Report*, February 25, 2014, accessed on April 10, 2014, http://www.usnews.com/news/special-reports/articles/2014/02/25/the-common-core-math-standards-content-and-controversy.
[10] Barry Garelick, "A New Kind of Problem: The Common Core Math Standards," *The Atlantic*, November 20, 2012, accessed on April 10, 2014, http://www.theatlantic.com/national/archive/2012/11/a-new-kind-of-problem-the-common-core-math-standards/265444/.
[11] The CCSS pedagogical agenda is based on a constructivist theory of education, in which conceptual understanding (children "construct" their own way of determining the answer) precedes the mastery of practical skills.
[12] Garelick, "A New Kind of Problem: The Common Core Math Standards," *The Atlantic.*
[13] "Common Core State Standards for Mathematics," Common Core State Standards Initiative, p. 15, accessed on April 10, 2014, http://www.corestandards.org/wp-content/uploads/Math_Standards.pdf.
[14] Ibid.
[15] Andrew Porter, Jennifer McMaken, Jun Hwang, and Rui Yang, "Common Core Standards: The New U.S. Intended Curriculum, *Educational Researcher*, 40(3) (April 2011): pp.103-116, accessed March 19, 2014, http://iowaascd.org/files/8813/2543/8288/CommonCoreResearch010112.pdf, (pp. 113-114).
[16] Ibid., (p. 109).
[17] Ibid., (pp. 113-114).
[18] Valerie Strauss, "A ridiculous Common Core test for first graders," *The Washington Post,* October 31, 2013, accessed on April 17, 2014, http://www.washingtonpost.com/blogs/answer-sheet/wp/2013/10/31/a-ridiculous-common-core-test-for-first-graders/.
[19] Anthony Cody, "Common Core Standards: Ten Colossal Errors," *Education Week Teacher*, November 16, 2013, accessed on April 10, 2014, http://blogs.edweek.org/teachers/living-in-dialogue/2013/11/common_core_standards_ten_colo.html.
[20] Child psychologist Jean Piaget who extensively studied the cognitive development of children, indicated that the "concrete operational stage" (ages 7-11) permits some inductive logic, but *deductive* logic, such as the one described for 4th graders (age 9) in PARCC tests from www.ccsstoolbox.com, is beyond them.
[21] "International Benchmarking," Achieve, accessed on April 10, 2014, http://www.achieve.org/international-benchmarking.
[22] Michael Alison Chandler, "Are math textbooks ready for Common Core?," *The Washington Post,* February 24, 2014, accessed on April 10, 2014, http://www.washingtonpost.com/local/education/are-math-textbooks-ready-for-common-core/2014/02/24/b937a3a0-9d61-11e3-9ba6-800d1192d08b_story.html.
[23] The Hechinger Report, "The Common Core Math Standards: Content and Controversy," *U.S. News & World Report.*