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The Cognitive Science Behind the Common Core

By Max Marchitello and Megan Wilhelm September 2014

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Introduction and summary

Raising academic standards has been part of the education policy discourse for decades. As early as the 1990s, states and school districts attempted to raise student achievement by developing higher standards and measuring student progress according to more rigorous benchmarks.[1] However, the caliber of the standards—and their assessments—varied greatly from state to state. For example, Massachusetts adopted some of the highest standards and most challenging exams in the country and has some of the highest-achieving students in the nation. On the other hand, Mississippi set a low bar, and the state's students are often ill prepared for college and careers.[2]

Recognizing that the previous patchwork system did not work, a group of bipartisan governors and state superintendents came together to develop a shared set of more rigorous, internationally benchmarked academic standards in English language arts and mathematics called the Common Core State Standards. Some worry that the standards have not been proven to improve student learning, as they were entirely new as of 2010. However, the Common Core is grounded in the latest cognitive science regarding how students learn. For this reason, there is a preponderance of evidence that strongly suggests the Common Core will improve the quality of education for all students.

Educators, content specialists, and other experts wrote the standards with the goal of preparing all students for college and careers. With that goal in mind, the developers first wrote the standards for high school and worked backward down to kindergarten, ensuring that the standards scaffold smoothly from one grade to the next and lead to college and career readiness. This structure creates a logical progression through the standards, helping educators teach their students stackable knowledge and skills as they move through school.

Unlike prior state standards, the Common Core sets uniform expectations that are grounded in the knowledge and skills every child needs to be successful after high school. Decades of research about how students learn and the best practices for teaching challenging content are embedded directly into the standards. As a starting point, the authors of the Common Core relied on earlier

college- and career-readiness standards developed by Standards for Success; the American Diploma Project; American College Testing, or ACT; the College Board; and the Texas Higher Education Coordinating Board. The Common Core authors also consulted with content experts such as the National Council of Teachers of Mathematics, states with high-quality standards, and high-performing nations such as Singapore and Korea.[3]

The standards were then revised based on feedback from educators, state education agencies, and public comments. Finally, a 28-member validation committee—comprised of K-12 and higher-education teachers and researchers—reviewed the standards.[4] After months of review and revision, the committee confirmed that the standards covered the knowledge and skills necessary for students to be ready for college and careers.[5] Recognizing the Common Core's potential to dramatically improve American public education, the majority of states rushed to adopt the standards when they were released in 2010.[6]

Although some teachers, students, and parents may feel a degree of anxiety as their classes transition from the old standards to the Common Core, they should be confident that their efforts will pay off. The Common Core is grounded in cognitive science and incorporates practices that have been proven to improve student learning and achievement. A review of the research base for the standards found that the Common Core promotes greater student learning in the following key ways:

- Scaffolding student learning to provide a strong knowledge base on which new ideas and concepts are stacked
- Holding all students to high expectations, which promotes greater student achievement and growth
- Incorporating the latest research on how students learn to read to help close the literacy gap
- Employing both the traditional method of teaching math and conceptual strategies to provide students with a strong understanding of math and the skills to apply it

- Increasing the opportunities for students to learn from their peers and collaborate on assignments, which improves learning and interpersonal skills

- Promoting problem- and project-based learning, which leads to a deeper understanding of concepts

The Common Core was designed to raise the bar for student achievement in the United States. The standards enjoy strong support from a diverse coalition of leaders from the civil rights, business, military, teacher, school administrator, and parent communities. If teachers and students are supported with high-quality curricula and instructional materials, a properly implemented Common Core will help prepare students to be complex problem solvers, as well as critical thinkers and readers. These six research-based practices get to the heart of how the Common Core will make that goal a reality for all students.

Knowledge scaffolding and student learning

Research on the science of learning over the past few decades has increasingly demonstrated that prior knowledge is a critical and often determining factor in how well a student learns new concepts. In fact, some researchers believe that prior knowledge exceeds aptitude in determining learning[7]—that what students know is more important than their raw intelligence. While some might dispute this view, it is clear that, as Marilla Svinicki of the University of Texas aptly put it, "What [students] don't know can hurt them"—in other words, students' prior knowledge affects how they receive and organize new information.[8] Without the necessary prior knowledge, students face significant challenges in learning new material.

Teaching students individual facts can seem frivolous at first. A frustrated student might ask, "Why do I need to know when Archduke Franz Ferdinand was assassinated?" Truthfully, it is probably not necessary to know that isolated fact. However, combining it with hundreds of other similar facts about World War I builds a knowledge schema that enables complex understanding of the event. Without this foundational knowledge, it would be impossible for a student to analyze the role of international treaties in starting World War I. There is a logical progression of knowledge and skills that students should be taught. Simply put, one must learn addition—both the concept and the practice—before one can perform multiplication.

Knowledge scaffolding—in which new topics incrementally build on students' prior knowledge—is precisely how teachers structure their units and lessons. When they introduce new content, they build the new information on top of students' prior knowledge and then ask students to think critically about it. For example, it would be unreasonable for a teacher to expect students to critique one of Shakespeare's plays without first establishing a firm understanding of the work's historical context and form. Instead, the teacher would gradually introduce the history of Elizabethan England, how to read poetry in a dramatic setting, and early modern stagecraft. It is only by acquiring the foundational knowledge of Shakespeare that students can effectively analyze his work.

The Common Core incorporates the instructional practice of scaffolding directly into its standards. The Common Core is designed to enable students to build a strong foundational understanding and then to expand on that prior knowledge with increasingly complex material that requires analysis and critical thinking. By focusing on a smaller range of standards but requiring deeper engagement with knowledge and skills, the Common Core provides additional time for teachers and students to focus on more robust inquiries into new concepts.

From the earliest grades through high school, the Common Core gradually deepens student knowledge, introduces new skills, and requires students to apply them. The past two decades of evidence reveal that students learn best when they can relate the new ideas they are learning to what they already know. The Common Core puts this into practice by scaffolding both the reading and math standards.

Holding all students to high expectations

The expectations set for students often are a self-fulfilling prophecy. In other words, the more that is expected of students, the more they are able to do. Students who are held to higher expectations are given more opportunities, more challenging material, and more direct support. Sadly, the inverse is also true: Students who are subjected to the "soft bigotry of low expectations"[9] are less likely to excel.

The effect of teacher expectations on student-learning outcomes—coined the Pygmalion Effect—has been well documented for nearly 50 years. Social psychologists Robert Rosenthal and Lenore Jacobson conducted a study in 1964 of the relationship between teacher expectations and student achievement. They administered an exam to assess student-growth potential but provided the teachers with a list of randomly selected, academically "promising" students instead of a list of students based on the test results.[10] At the end of the year, the students who were identified as promising significantly outperformed their peers when tested again.

Researchers conclude that when authority figures such as teachers have higher expectations for students, they:[11]

- Convey greater warmth and encouragement, often through nonverbal communication
- Provide access to more challenging material
- Give increased learning opportunities and additional time
- Offer more targeted and detailed feedback

Low expectations commonly affect students from disadvantaged backgrounds. Far too often, students' socioeconomic or racial characteristics trigger generalized stereotypes that can lower teachers' expectations. Considerable evidence suggests that racial and socioeconomic differences between teachers and students can lead to lower perceptions of the students' academic potential.[12]

In an analysis of data from the National Education Longitudinal Study, sociologist Gary Oates studied the prevalence and impact of disparate perceptions of students by teachers of different races. He found that white teachers most often held lower perceptions of black students, which contributed to lower performance on standardized tests. He argued, "Teacher perceptions—particularly *white* teacher perceptions—[are] integral to the question of how reduction of the black-white gap in scholastic performance can be accomplished."[13] Nearly 82 percent of teachers in public and private schools identified as white as of 2012, so it is necessary to consider the effect of teacher expectations on student achievement as the U.S. population becomes increasingly diverse.[14] Oates further argued that delivering clear, positive expectations of success to all students is an effective way to improve student achievement and address race-based achievement gaps.[15]

The evidence of the power of teacher expectations either to promote or stymie student growth is overwhelming. Indeed, teacher expectations can have a greater effect on student achievement than even socioeconomic and demographic factors,[16] and many studies have examined the relationship between high expectations and student achievement.[17] One such study followed students for five years and found that those who had teachers with high expectations had higher educational performance than students who had teachers with low expectations.[18] In 2013, psychology and education researchers from Rutgers University and the University of Virginia investigated the effects of student, parent, and teacher expectations on academic outcomes after high school graduation and reported that positive teacher expectations in 10th grade "stood out as having the greatest predictive power" for a student's postsecondary status four years later.[19]

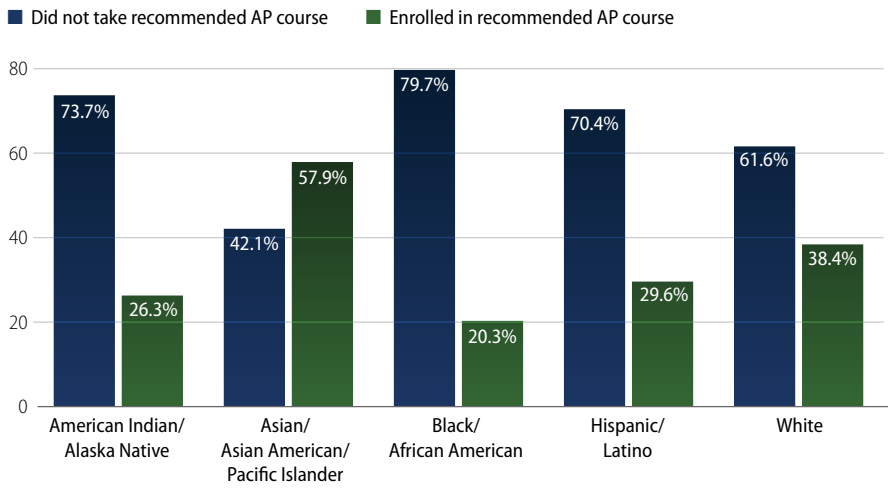
A culture of high expectations is critical to improving student learning and is also a hallmark of a successful school. When students are taught to high standards and held to high expectations, they are more likely to rise to the challenge. This is particularly important in schools that serve disadvantaged students who suffer from low expectations and limited academic opportunities.[20]

While difficult to measure, one strong indicator of a school culture of high expectations is whether or not students participate in Advanced Placement, or AP, courses, typically the most challenging classes in high school. Despite ever-increasing AP enrollment, the majority of students with Preliminary Scholastic Aptitude Test, or PSAT, performances that indicate they would benefit from enrolling in an AP class do not participate.[21] The disparity between AP-ready students and those who participate is most pronounced among students of color.

This gap is a symptom of low academic expectations in which even students who are ready for more advanced work do not receive it.

FIGURE 1

AP participation in recommended courses by race/ethnicity



Source: College Board, "The 8th Annual AP Report to the Nation" (2012), available at http://apreport.collegeboard.org/sites/default/files/downloads/pdfs/AP_Main_Report_Final.pdf.

The Common Core helps address this problem by establishing a strong culture of high expectations and ensuring that college and career readiness is expected of all students, not just a select few. All children—regardless of race, disability, native language, or ZIP code—will be taught to be critical thinkers, complex problem solvers, and compelling writers. These skills are crucial to success after high school, and all students are expected to learn them under the Common Core. The research is clear: Holding students to higher expectations is critical to improving achievement and to preparing students for college and careers.

Incorporating the latest research on teaching literacy

Reading is the most important skill students learn in school. Without a strong foundation in reading, academic success in every subject, even mathematics, can be a struggle. Falling behind—particularly in the early grades—can have significant negative consequences throughout students' academic careers.

Since teaching reading is challenging even for the most experienced teacher, serious efforts to develop a science of reading began roughly 50 years ago. The research on teaching literacy has yielded many effective practices. According to the National Reading Panel—created by Congress in 1997 to determine the best ways to teach reading based on existing research—there are five essential components of reading: phonemic awareness, phonics, fluency, vocabulary, and comprehension. Highly effective reading instruction addresses all five of these components using a systematic, explicit instructional approach.[22]

An extensive research base shows the literacy skills students need to learn and identifies key instructional practices that effectively improve reading achievement.[23] Researchers from the University of Michigan, Rutgers University, and Clemson University have presented an in-depth review of evidence-based practices in literary instruction that result in high reading achievement, such as differentiating instruction according to unique student needs and scaffolding instruction in the five essential components of reading.[24] For each of the five components, there is a wealth of evidence that supports the use of specific instructional practices to ensure that students become skilled readers.[25]

The essential components of reading have been identified, and educators and literacy specialists know how to tailor literacy instruction to produce results. Yet alarmingly, 32 percent of fourth graders and 22 percent of eighth graders scored "below basic" on the 2013 National Assessment of Educational Progress, or NAEP, reading assessments, demonstrating only a rudimentary reading ability.[26] It is estimated that the rate of reading failure in the United States could be greatly reduced if practices derived from science were regularly applied in classroom instruction, rather than practices based on education ideologies.[27]

Effective reading teachers use instructional approaches that have been proven to help students develop the essential reading skills. However, many schools of education are not fully incorporating research-based instructional methods into their teacher-training programs.[28] The National Council on Teaching Quality, or NCTQ, reviewed the early reading instruction courses of 959 elementary and special-education programs. It found that only 34 percent of these programs adequately prepared teaching candidates with reading instruction that addressed four out of the five essential components of reading. Furthermore, 56 percent were classified as inadequately preparing teachers for effective reading instruction.[29]

Although the Common Core does not explicitly require teacher-preparation programs to use specific methods to teach literacy standards, it will likely necessitate curriculum revisions in teacher-training programs to prepare teachers for the Common Core's more rigorous reading standards.[30] Some programs are already making curriculum changes in order to meet the challenges presented by higher standards. For example, professors at Southeastern Louisiana University in Hammond, Louisiana—a top-ranked NCTQ teacher-training program in the southern region[31]—now focus on preparing their students to evaluate nonfiction texts' complexity.[32]

The Common Core also incorporates the science of reading in that its standards are structured to be developmentally appropriate and to help students learn the foundational reading skills that they build upon as they advance from grade to grade. P. David Pearson, a professor in the Graduate School of Education at the University of California, Berkeley, told *Education Week* that the two big ideas underlying the Common Core—building knowledge through close reading of texts and reading within rich content areas—are "consistent with the last 20-30 years of research" and reflective of the shifting focus of reading research in the past 10 to 15 years.[33] Dorothy Strickland of Rutgers University agrees, saying that the Common Core "leverages emerging research on how students analyze and verify what they read in different types of text, from literature to a lab report or an Internet blog."[34] For example, the Common Core kindergarten literacy standards require explicit instruction on letters and sounds—phonics and phonemic awareness—which research shows is associated with stronger literacy skills.[35]

Example of relevant standards in the Common Core

- **English Language Arts: Reading, Foundational Skills, Kindergarten (CCSS.ELA-LITERACY.RF.K.3.A)**
  "Demonstrate basic knowledge of one-to-one letter-sound correspondences by producing the primary sound or many of the most frequent sounds for each consonant."[36]

- **English Language Arts: Reading, Foundational Skills, Kindergarten (CCSS.ELA-LITERACY.RF.K.3.B)**
  "Associate the long and short sounds with the common spellings (graphemes) for the five major vowels."[37]

Research strongly suggests that combining the Common Core standards with science-based reading instruction will yield powerful academic results and reduce the alarming percentage of students reading below basic levels of proficiency.

Employing both traditional and conceptual strategies to teach math

Students believe that math—perhaps more than any other subject taught in school—is something one is either good at or not, an idea that often extends into adulthood. This phenomenon has its roots in how math is taught in school. For generations, math classes followed more or less the same pattern: The teacher introduces a new procedure, the teacher leads the class through solving a few problems of that type, and the students then work individually to solve similar problems on their own. In this model, math is something that is shown, practiced, and memorized.[38] As a result, there develops a significant difference between understanding math and doing math.

Learning math only through a drill-and-kill approach—in which students practice one type of problem over and over through endless worksheets—contributes to the low performance of Americans in math. During the 1980s, psychologist Sylvia Scribner found that dairy-factory workers with little to no formal schooling performed complex mathematical calculations with greater success than their better-educated co-workers.[39] Cognitive science research that studied students and adults who were poorly educated but who could perform rigorous mathematics found that forcing them to use the mathematical processes taught in school actually decreased their performance compared with the methods they taught themselves.[40] These findings suggest that the way math is taught limits students' creativity, problem solving, and ability to apply what they have learned to real-world problems.

The National Council of Teachers of Mathematics and theorists such as Magdalene Lampert suggested that redesigning the traditional structure of how students learn math—introduction, guided practice, and independent study—would help improve students' conceptual understanding of math and consequently improve their performance.[41] Under this new conceptual framework, students first attempt to solve a new problem on their own by applying their prior mathematical knowledge. Then, they work collaboratively with their peers. Finally, the class—with the teacher's guidance—works together to find different paths to the solution.

Example problem using traditional and conceptual strategies

Elizabeth is at the grocery store buying fruit for the week. She wants to purchase $7.60 worth of apples with a $20.00 bill. How much change should the cashier return to Elizabeth? Illustrate your answer.

Using the traditional method, the student would simply write:

$20.00
-$7.60
$12.40

However, this does not teach the student to do math as it is done in everyday life; it simply involves plugging new numbers into an algorithm learned through hours of rote memorization. Under the Common Core, the student instead would follow a process similar to Elizabeth's actual mental computation while standing at the register:

$7.60 + $.40 = $8.00
$8.00 + $2.00 = $10.00
$10.00 + $10.00 = $20.00

The cashier should give Elizabeth $12.40 in change.

This is exactly how someone with a strong grasp of numeracy does calculations on a daily basis. Furthermore, solving the problem in this way teaches the relationship between different values far more effectively than the traditional method of plugging numbers into a formula. It is critical that students grasp the concepts behind subtraction before they rely solely on the traditional algorithm.[42]

Lampert argues that, at every level, students should be "making conjectures, abstracting mathematical properties, explaining their reasoning, validating their assertions, and discussing and questioning their own thinking and the thinking of others."[43] This approach more closely mirrors how mathematicians practice math: challenging their assumptions and testing hypotheses. In a recent review of existing evidence on the efficacy of elementary mathematics programs, Robert Slavin and Cynthia Lake examined the impact of programs focused on mathematics curricula, computer-assisted instruction, and instructional processes. They found that programs that adjust the teacher-student relationship, change how math is taught, and introduce high-impact practices—such as students learning collaboratively—have the greatest positive effect on student outcomes.[44] Although teaching math in this way warrants additional study, existing research strongly suggests that a more discovery-based approach will help students achieve a more substantive understanding of mathematical concepts and theories.

> *"I love how the Common Core focuses on fewer standards at each grade level so that students can go more in depth with their learning. The way that we are teaching now, specifically in math, really helps develop actual understanding of what they are doing, instead of just memorizing a process of steps or an algorithm."*[45]
>
> *– Rachel Ziegler, fourth-grade teacher with eight years of experience, New Haven, Connecticut*

The Common Core combines this conceptual approach to math with the more traditional approach. The idea is to provide students with ample opportunity to build a strong base understanding of the underlying mathematical concepts rather than just memorize the rules. However, the standards also include time for students to practice how to apply the concepts they have learned. Overall, the standards are structured to afford students sufficient time to gradually increase their comprehension of mathematics while also continuing to build a strong foundation in applying those concepts.

Teaching math is hard, and teaching it differently from how you learned it is harder still. Unsurprisingly, some instructional materials developed to teach conceptual math are confusing and misleading.[48] Some publishing companies contribute to this problem by haphazardly repackaging their old materials and claiming that they are aligned with the Common Core.[49] To mitigate the problem of poorly structured math assignments, districts and schools must provide high-quality professional development to math teachers. When teachers are prepared, the evidence suggests that learning math in this way has a significant positive impact on student understanding and learning.

Example of relevant standards in the Common Core

Mathematics: Reading, Number & Operations in Base Ten, Grade 4 (CCSS.MATH-Content.4.NBTB.4)
"Fluently add and subtract multi-digit whole numbers using the standard algorithm."[46]

Mathematics: Reading, Number & Operations in Base Ten, Grade 4 (CCSS.MATH-Content.4.NBTB.5)
"Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models."[47]

Increasing opportunities for student collaboration

The traditional model of a classroom—desks arranged in rows with the teacher lecturing at the front of the room—is increasingly a thing of the past. Instead, schools and teachers strive to create a more dynamic learning environment in which students collaborate to solve problems and work together on projects. The idea that education is a structured exchange of knowledge and information that flows directly from teachers to students is quickly eroding. Instead, the opportunity to work collaboratively with peers can have a profound effect on learning and academic achievement.

Identifying the unique peer effect on student achievement can be quite difficult for methodological reasons. Yet in a study of peer effects on third- through sixth-grade student performance, economist Caroline Hoxby found that a "change of 1 point in peers' reading scores raises a student's own score between .15 and .4 points" on the Texas Assessment of Academic Skills, or TAAS, test.[50] However, all of the variation cannot be attributed purely to differences between peers' achievement levels. For example, Hoxby found that both girls and boys have greater math achievement in classes with higher numbers of female students, even though girls and boys score similarly on the TAAS test. She also found that peer effects were stronger among students of the same race. Nevertheless, the impact of students' peers on their own academic performance was significant.

Practices such as peer tutoring also have a dramatic, positive impact on student achievement. In Kansas City, Kansas, researchers compared a class-wide peer-tutoring program with traditional teacher-led instruction.[51] The study included three different sixth-grade classes taught by the same teacher. The first consisted of a traditional class structure; the second engaged in class-wide peer tutoring; and the third added a reward lottery to the peer-tutoring program. The peer-tutoring students were organized into mixed-ability dyads, with each taking turns tutoring the other.

During the 19 weeks of the study, the peer-tutoring students dramatically improved their performance on weekly reading tests. In fact, the positive effect of peer tutoring on students' academic achievement was so significant that the teacher incorporated it into her class that was only receiving direct instruction. The baseline test scores for each of the three classes were 62 percent, 58 percent, and 58 percent, and scores improved to 81 percent, 74 percent, and 74 percent, respectively, over the course of the study. This translates to a two letter-grade improvement in reading performance.

Similarly, an analysis of five studies of peer-delivered corrective reading programs for struggling students found significant improvement in reading performance and fluency. The results were consistent whether the participants were diverse English language learners, at-risk high school and elementary school students, or even the peer tutors themselves.[52] For example, researchers from Eastern Washington University analyzed a peer-administered corrective reading program and found that students who originally scored below grade level on the pretest performed at or above grade level after completing the program.[53]

In addition to structured peer tutoring, collaborative learning in general has considerable academic benefits. Reviews of the existing body of research on collaborative learning have shown that student collaboration is associated with critical thinking and problem-solving skills, as well as with higher achievement.[54] For example, Craig Bowen of Clemson University found that high school and college students in a collaborative learning environment had higher achievement in chemistry compared with students in traditional learning environments.[55]

Classroom collaboration is effective in a variety of subjects for both elementary and secondary students—especially for English language learners, a fast-growing population of students.[56] Collaborative learning also improves classroom relations between students and teachers.[57] One study revealed that students who engage in collaborative learning not only perform better in mathematics but also have a more positive attitude toward the subject.[58]

The Common Core includes specific content-related standards but also goes a step further with the College and Career Readiness Anchor, or CCRA, standards, which incorporate higher-order cognitive strategies that are directly related to future college and career success. The Speaking and Listening CCRA standards have a whole section devoted to "Comprehension and Collaboration."[59] The Common Core CCRA standards complement and broaden the more specific grade-level standards, and they are designed to ensure that students are able to transition into college or the workforce with the necessary skills to succeed in these increasingly collaborative environments. The Common Core includes CCRA standards aimed at developing reading, writing, speaking, listening, and language skills.[60]

Example of relevant standards in the Common Core

English Language Arts: Literacy, College and Career Readiness Anchor for Speaking and Listening (CCSS.ELA-LITERACY.CCRA.SL.1)

"Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively."[61]

Comparing student activities before and after the Common Core

	Task before Common Core	Task with Common Core
Kindergarten and first grade	Students retell the main events—for example, the beginning, middle, and end—of Frog and Toad Together and identify the characters and setting of the story.	Students compare and contrast the adventures and experiences of Frog and Toad in Frog and Toad Together and participate in collaborative conversations about their comparisons.

Source: Foundation for Excellence in Education, "Old Standards v. Common Core: A Side-by-Side Comparison of English Language Arts," available at **http://excelined.org/common-core-toolkit/old-standards-v-common-core-a-side-by-side-comparison-of-english-language-arts-2/** (last accessed August 2014).

The Common Core standards go beyond simply requiring students to learn a particular list of facts. Indeed, these rigorous standards push students to develop a set of life skills. The Common Core's emphasis on collaborative learning skills encourages schools and teachers to adopt instructional practices that will help students become effective communicators, problem solvers, and critical thinkers. Students who develop strong collaboration skills in school will be in a better position to succeed in college and the workplace. They will also be well prepared to meet the expectations of future professors, employers, and colleagues.

Promoting problem- and project-based learning

Students often feel that what they learn is not directly relevant to their daily lives and experiences. When this happens, they may disengage from class and become bored, which is likely to hinder their intellectual development. A 2012 report on student engagement by the Center for Evaluation & Education Policy at Indiana University Bloomington revealed that 66 percent of high school students are bored in class "every day." Only 2 percent of students said that they were "never bored."[62] One way educators have sought to address low student engagement is through problem- and project-based learning, or PBL, which involves learning through inquiry and solving open-ended problems with real-world authenticity.

Recognizing that the knowledge and skills students are taught must be relevant to their lives, the Common Core places particular emphasis on real-world problem solving and the practical application of what students have learned. The Common Core standards also require students to work toward deeper understanding and the development of higher-order cognitive skills. The Common Core's emphasis on real-world applicability will likely lead to changes in classroom instruction.

Teaching using PBL is an effective way for students to apply the knowledge and skills they already have in order to discover solutions to unfamiliar problems or situations. PBL helps ensure the material is relevant to students' lives, experiences, and future careers—an approach that improves student academic outcomes. A recent study of sixth-grade students examined the differences in comprehension and application for comparable student groups that received either PBL instruction or lecture and discussion instruction. Students who were taught using PBL demonstrated "better long-term retention and ability to apply new material."[65]

Example of relevant standards in the Common Core

Mathematics: Standards for Mathematical Practice (CCSS.MATH.PRACTICE.MP1)

"Make sense of problems and persevere in solving them."[63]

Mathematics: Content Standards, eighth grade, expressions and equations (CCSS.MATH.CONTENT.8.EE.C.8.C)

"Solve real-world and mathematical problems leading to two linear equations in two variables."[64]

PBL can also enhance and sustain student motivation and engagement in learning.[66] This learning style can be especially effective in science, technology, engineering, and mathematics, or STEM, subjects. One study found that over the course of three years, students benefited academically from participating in STEM PBL activities, and low-performing students showed more improvement in mathematics test scores than middle- and high-performing students.[67] This finding indicates that PBL could be an effective instructional tool to narrow the achievement gap for low-performing students.

A key to high-quality education is helping students realize that there are often multiple solutions and many different approaches to solving a problem—but simply telling them that is not enough. It is important to actively engage students in what they are learning and to provide them with opportunities to apply what they know to their lives. The benefits of relevant PBL are well documented, and the Common Core standards encourage teachers to engage students in meaningful learning by promoting the development of skills that students can apply to real-world problems.

Conclusion

Unlike other recent education reforms—such as targeted reading programs—the Common Core establishes a new educational foundation grounded in decades of research on how students learn and the best teaching practices: knowledge scaffolding, holding all students to high expectations, the science of learning to read, conceptual math, collaborative learning, and problem-based learning.

By incorporating evidence-based practices directly into the standards themselves, the Common Core ensures all students are being held to the same expectations and are receiving instruction that is aligned with what works. At the same time, the standards leave room for teachers, districts, and states to develop their own curricula and instructional materials. This flexibility allows educators to adapt their instruction to meet the needs of their students while maintaining common, rigorous standards—regardless of students' socioeconomic backgrounds.

Although switching to the more rigorous standards of the Common Core presents a significant challenge, the evidence suggests it likely will improve student achievement because it is entirely based on proven strategies that help students learn and grow.

About the authors

Max Marchitello is a Policy Analyst for the Pre-K-12 Education Policy team at the Center for American Progress. He has principally focused on accountability, standards, assessments, school finance, and education issues related to low-income students and students of color. Prior to joining the Center, Marchitello served as the inaugural William L. Taylor fellow for education policy at The Leadership Conference on Civil and Human Rights. He also taught high school English and coached basketball in North Philadelphia.

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