Research

How Building Knowledge Boosts Literacy and Learning

First causal study finds outsized impacts at "Core Knowledge" schools

EDUCATORS AND RESEARCHERS have been fighting the reading wars for the last century, with battles see-sawing literacy instruction in American schools from phonics to whole language and, most recently, back to phonics again. Policymakers have entered the fray, after more than a quarter-century of stagnant reading scores in the United States. Over the last decade, 32 states and the District of Columbia have adopted new "science of reading" laws that require schools to use curricula and instructional techniques that are deemed "evidence-based."

Such reading programs include direct instruction in phonics and reading comprehension skills, such as finding the main idea of a paragraph, and efforts to accelerate learning tend to double down on more of the same skill-building practice. But research increasingly points to another critical aspect of literacy: the role of student knowledge. For example, prior research by two of us found that a young child's knowledge of the social and physical world is a strong predictor of their academic success in elementary school. And advocates for knowledge-based education often cite the so-called "baseball study" where students reading a passage about baseball who knew about the sport were far better at understanding and summarizing the story than students who didn't, regardless of their general reading skills.

Knowledge-building reading curricula are rooted in these insights, and use materials and activities based on a sequence of integrated science and social studies topics, texts, and vocabulary. Yet the potential value of this approach is often an afterthought in state and district efforts to strengthen reading instruction, and the benefits to students of combining evidence-based curriculum with systematic efforts to build student knowledge have yet to be rigorously documented.

We conduct the first-ever experimental study of this topic, based on randomized kindergarten-enrollment lotteries in nine Colorado charter schools that use an interdisciplinary knowledge-based curriculum called Core Knowledge. To assess the long-term impact of experiencing a knowledge-building curriulum on student learning, we compares performance on statewide tests in grades 3–6 between kindergarten lottery winners who attended a Core Knowledge charter school with lottery losers who could not enroll,

We find that winning an enrollment lottery and enrolling in

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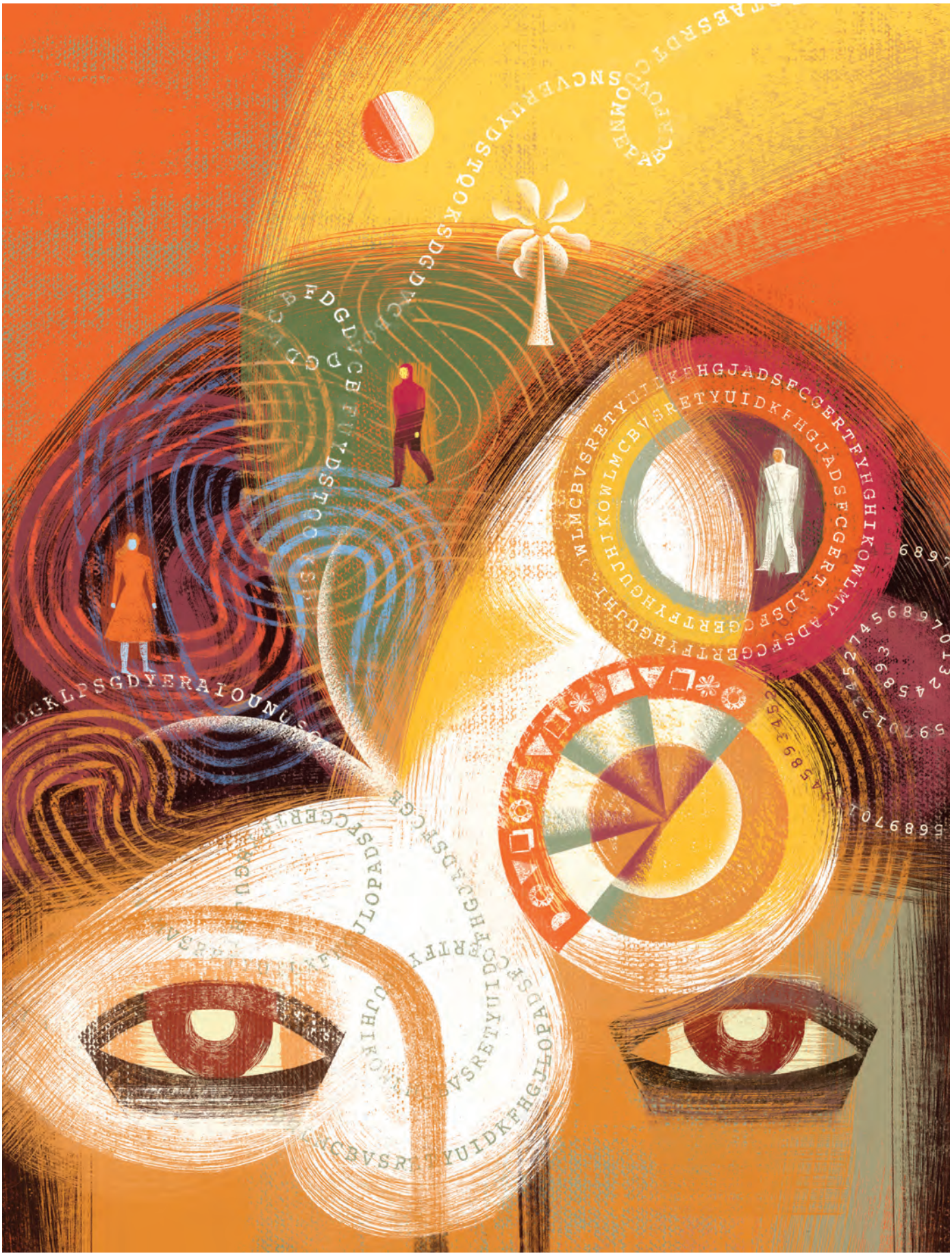

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a Core Knowledge charter school boosted long-term reading achievement in 3rd to 6th grade by 16 percentile points, as compared to comparabel applicants who did not win their enrollment lottery. The size of this gain is approximately equivalent to the difference between the mediocre performance of U.S. 13-year-olds on the 2016 Progress in International Reading Literacy Study and that of top-scoring countries like Singapore and Finland. Our results are also notable in their contrast with other studies of reading interventions, which typically find small, short-term effects.

Students and teachers in many public elementary schools spend up to two hours each day on reading instruction. While the component skills of literacy are critical to student development and learning, our findings point to a missed opportunity to accelerate literacy by building knowledge at the same time. Skill building and knowledge accumulation are separate but complementary cognitive processes, and while the adage "skill begets skill" may be true, a fuller description of cognitive development could be "skill begets skill, knowledge begets knowledge, and skill combined with knowledge begets them both."

Kindergarten Lotteries for "Core Knowledge" Charters

The Core Knowledge curriculum was created in the 1980s by E.D. Hirsch, Jr., a researcher and advocate of knowledge-building education. Its content and activities follow a planned sequence of the knowledge and skills students should accumulate and master in grades K–8 in all academic subjects and the arts. This "knowledge-based schooling" approach is rooted in the belief that a common base of shared knowledge is foundational for not just individual students' reading comprehension abilities but also for our ability as a society to communicate and promote equal opportunity. An estimated 1,700 schools across the U.S. use the curriculum today, including more than 50 in Colorado.

Evidence-based reading programs include direct instruction in phonics and reading comprehension skills. Research increasingly points to another critical aspect of literacy: the role of student knowledge.

To assess the impact of the Core Knowledge curriculum on student achievement, we look at nine oversubscribed Colorado charter schools that all use the curriculum, had been open for at least four years, and held random enrollment lotteries to register kindergarten students in either or both of the 2009–10 and 2010–11 school years. Our study includes 14 separate lotteries with 2,310 students, almost all of whom are from high- or middle-income families.

These families generally have a range of schooling options, including private schools, other charter schools, and public schools outside their district under Colorado's open-enrollment law. About one in five students in our sample applied to multiple charter lotteries—usually two instead of one. Some 41 percent won at least one lottery, and 47 percent of winners enrolled in that school. In all, 475 lottery winners went on to attend a Core Knowledge charter, while 1,356 students did not win the lottery and attended school elsewhere. In analyzing the effects of attending a Core Knowledge charter, we take into account the fact that not all lottery winners actually enrolled.

Attrition and Family Choice

We base our analysis on the performance of lottery applicants on the Partnership for Assessment of Readiness for College and Careers (PARRC) reading and math tests in grades 3, 4, 5, and 6, as well as the 5th-grade science PARRC test. By looking at these scores, we can compare the performance of students who did and did not experience a knowledge-building curriculum over up to seven years of their schooling.

However, roughly 36 percent of students in our sample did not complete all scheduled PARCC tests through grade 6, and the attrition rate for students who did not win the enrollment lottery is 5 percentage points higher than for lottery winners. Detailed student data reveals three major factors at play. First, some students stop participating in Colorado's PARCC testing because they move out of state, transfer to a different school, or are homeschooled. A second group of students don't have test-score data because they are exempted as language learners or special-education students. Third, other students are off-track with their expected kindergarten cohort in later years because of delayed kindergarten entry ("redshirting") or due to having skipped or repeated a grade.

To ensure that this attrition does not skew our results, we exclude from our analysis both the four lotteries with the highest rates of differential attrition between lottery winners and losers and the youngest applicants, who are more likely to be redshirted by their parents regardless of their lottery outcome. We also adjust our results for students' gender, race or ethnicity, and eligibility for a free or reduced-price school lunch to ensure that any demographic differences between lottery winners and losers do not introduce bias.

Accelerated Achievement

We find positive long-term effects on reading performance for students who are randomly selected by a kindergarten enrollment lottery and attend a Core Knowledge charter school. Across

grades 3–6, these students score 47 percent of a standard deviation higher in reading than comparable lottery applicants who did not have a chance to enroll. This is equivalent to a gain of 16 percentile points for a typical student (see Figure 1). Students who attend a Core Knowledge charter also make outsized gains in science of 30 percent of a standard deviation, which is equivalent to a gain of 10 percentile points. Effects in math are positive, at about 16 percent of a standard deviation, but fall short of statistical significance.

The effects are slightly larger for female students than males (see Figure 2). In reading, female Core Knowledge charter students score 50 percent of a standard deviation higher compared to 44 percent for males, for a gain 17 of percentile points compared to 15 percentile points for males. Females gain about 12 percentile points in science and 9 percentile points in math, while males gain 6 percentile points in science and experience no gains in math. We also look at effects by student grade level and find no upward or downward trend, suggesting the effects may have stabilized by 4th grade (see Figure 3).

While prior non-experimental research has documented stronger reading performance among students who already have knowledge about a topic, our analysis shows positive long-term impacts in reading from systematically building student knowledge over time. In our view, these results suggest that the "procedural skills" approach that has dominated reading comprehension instruction over the last 30 years in public schools is less effective than a "knowledge-based" approach that teaches skills and also is designed to build a body of knowledge as the main mechanism for increasing comprehension.

These findings also build on the body of evidence linking students' levels of general knowledge to achievement in reading, science, and math. Research also shows that levels of general knowledge are strongly correlated with socio-economic status and parental levels of education. However, unlike these factors, knowledge is malleable through curricular choices. The intervention we study, where students experience seven years of a knowledge-building curriculum, appears to set off a long-term, compounding process whereby improved reading comprehension leads to increased knowledge, and increased knowledge leads to even better comprehension.

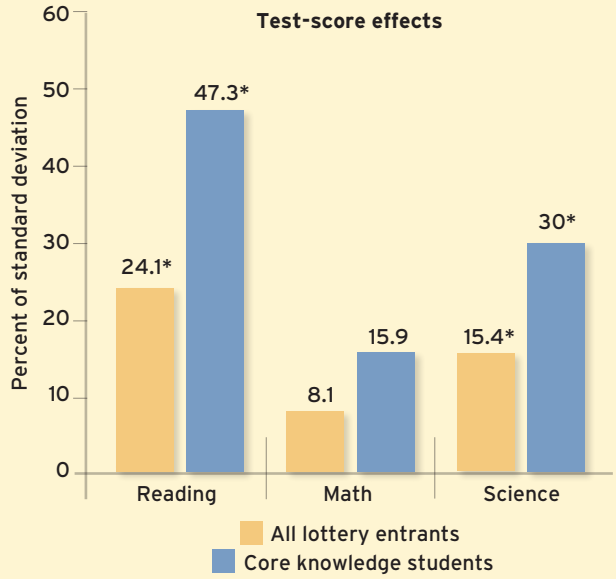
A Call to Build Knowledge About "Knowledge"

In addition to informing current-day decision-making, we believe these results should inspire a new research and policy agenda to measure and track students' knowledge development and understand the mechanisms involved in knowledge-building curricula. The effects our study finds are similar in pattern and magnitude to earlier non-experimental evidence, which suggests that gains in students' general knowledge could have a larger effect on future achievement than similar gains in more widely studied non-cognitive domains, such as executive function, visual-spatial and fine motor skills, and social and emotional development.

The potential benefits of knowledge-building curricula could be far-reaching. The compounding process our analysis reveals would occur not only in reading, but also across all subjects to the extent that they depend primarily on reading comprehension for learning. Moreover, these achievement gains across

Higher Achievement for Students at Core Knowledge Charter Schools *(Figure 1)*

Several years after entering a Kindergarten charter-school enrollment lottery, students who won the lottery and attended a Core Knowledge school did better on reading, math, and science tests in grades 3–6 compared to comparable lottery entrants who were not offered admission. The largest difference was in reading.



NOTE: Analysis based on student performance on annual PARCC tests in grades 3–6. Science is tested in 5th grade only. Sample includes 5,568 students from 10 charter-school lotteries and excludes applicants younger than 5.4 years (male) and 5.2 years (female).
* indicates significance at the 95 percent level.

SOURCE: Authors' calculations

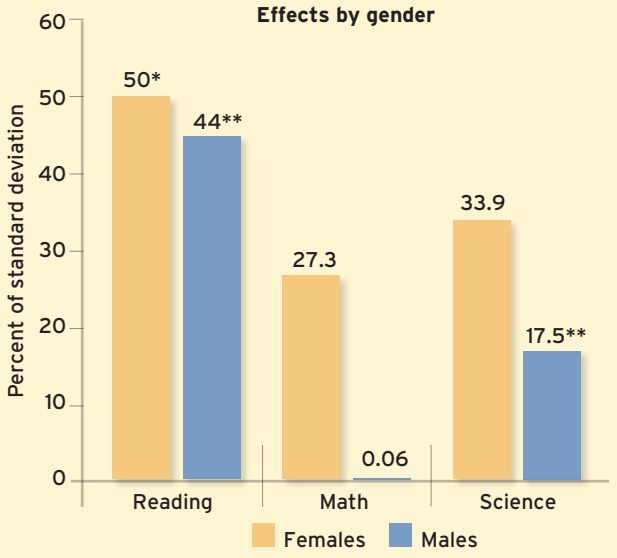
all subjects would likely extend into future years, as increased comprehension in one year leads to increased knowledge and comprehension in the next, and so on. We believe that these curricula could also increase students' educational attainment and future labor market success.

However, elevating student knowledge to a more central place and higher priority in research and policy will require a significant conceptual shift—the term "building knowledge" does not readily trigger a conceptual map linking the intervention to higher achievement, unlike common interventions like reducing class size, extending the school day, and raising teacher pay.

Well-designed measures of student knowledge should be considered as an important addition to other national measures for students in elementary grades. To be sure, they will carry an additional challenge. Any definition and measures of "general knowledge" will need both scientific validity and political viability at a moment when attempts to ban library books and shape course content are on the rise. Attempting to define what all public-school students should know will undoubtably trigger debates and a variety of viewpoints. However, the evidence points to building knowledge as a critical foundation of student literacy with potentially lifelong effects. The benefits of skillful reading and broad knowledge should be a shared starting point, from which a stronger approach to reading instruction can grow.

Bigger Benefits for Females *(Figure 2)*

Attending a Core Knowledge charter school increased learning in all subjects more for female than for male students.

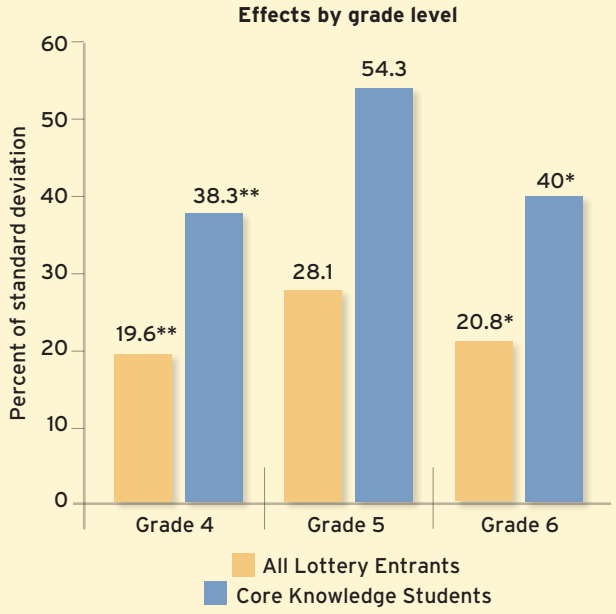


NOTE: See Figure 1. * indicates significance at the 95 percent level. **indicates significance at the 90 percent level.

SOURCE: Authors' calculations

Effects on Reading by Student Grade *(Figure 3)*

The benefits of attending a Core Knowledge charter school remain steady across grades 4-6, suggesting the effects may have stabilized by 4th grade.



NOTE: See Figure 1. * indicates significance at the 95 percent level. ** indicates significance at the 90 percent level.

SOURCE: Authors' calculations

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