The Impact of COVID-19 on Math Achievement

Without urgent attention, the problem of unfinished learning will compound as students advance to later grades.

Jennifer Sattem, Matt Dawson, and Elizabeth Peyser

States' annual testing data for spring 2021 showed that unfinished learning in the wake of COVID-19 is most pronounced—and most troubling—in math. In Texas, nearly 40 percent of students failed the state's math exam in 2021.[1] In Indiana, only 37 percent were proficient in math, down from 48 percent in 2019.[2] Many states saw similar results. National research by McKinsey & Company concluded that students were four months behind in math at the beginning of the 2021–22 school year.[3]

What makes the results such a cause for alarm is the sequential nature of math learning. Math skills build like a staircase. Teaching a second grader how place value relates to addition and subtraction computation allows them to understand multiple-digit multiplication in the fourth grade, which leads to concepts, such as the distributive property, in algebra. The challenges older students face relate directly to the degree to which they built a strong foundation in elementary and middle school. A student's mastery of fractions in the elementary years is a strong predictor of success in algebra and overall advanced math achievement, even when controlling for factors like socioeconomic status.[4]

Consider the difficulty confronting Jaden, a sixth grader who started this school year with fourth-grade math proficiency, as he attempts to solve a sixth-grade word problem: *Maria goes to the coffee shop. The store offers a pound of coffee for $9 or 8 ounces for $5. Which is the better bargain?*

The problem requires that Jaden compare two ratios, a progression that requires a new skill built off numbers and operations, algebra and algebraic thinking, measurement and data, and geometry. Jaden is expected to know that one pound equals 16 ounces and that he can use division to convert ounces into pounds. But he doesn't. His teachers in previous grades covered those concepts in classes he missed due to the challenges of remote learning, family illness, or a variety of other obstacles.

Should his math teacher deliver grade-level content to Jaden and his classmates, knowing that Jaden lacks the prerequisite skills and concepts to thrive? Or should she remediate by teaching the entire class fourth-grade material, which potentially robs Jaden of the chance to outperform expectations?[5] These questions plagued educators long before COVID-19. But given what test results say about unfinished learning, particularly in math, the need for answers is even more urgent.

Research on Unfinished Learning

Research from district-level interim assessments in many ways mirror what state assessments reveal about the impact of school closures and disruptions due to COVID-19.[6] For many years, districts have used these assessments, typically administered three times annually, to gather data teachers can use to guide instruction and support for students. With the cancellation of the 2020 state summative assessments during the pandemic, interim assessments also became critical tools for policymakers and researchers, providing a window into student achievement during an unprecedented series of disruptions to teaching and learning.

Our research draws on results from Curriculum Associates' i-Ready Diagnostic Assessment, taken by more than 10 million students across the country. Local diagnostic assessments,

like i-Ready, provide some of the best data available on student achievement over the previous two years. In our most recent research on unfinished learning—the fourth in a series—we examined student learning in the fall of 2021 compared with a pre-pandemic historical average.[7]

We found that fewer students in elementary and middle school started the 2021–22 school year ready for grade-level work. Every elementary and middle school grade exhibited unfinished learning in reading and math in fall 2021. However, students in early elementary grades, who are typically still learning to read, have not yet caught up to pre-pandemic on-grade-level performance. In math, the percentage of students who are on grade level is not yet reaching pre-pandemic levels in most grades, and the gaps are largest in upper-elementary and middle school grades (figure 1).

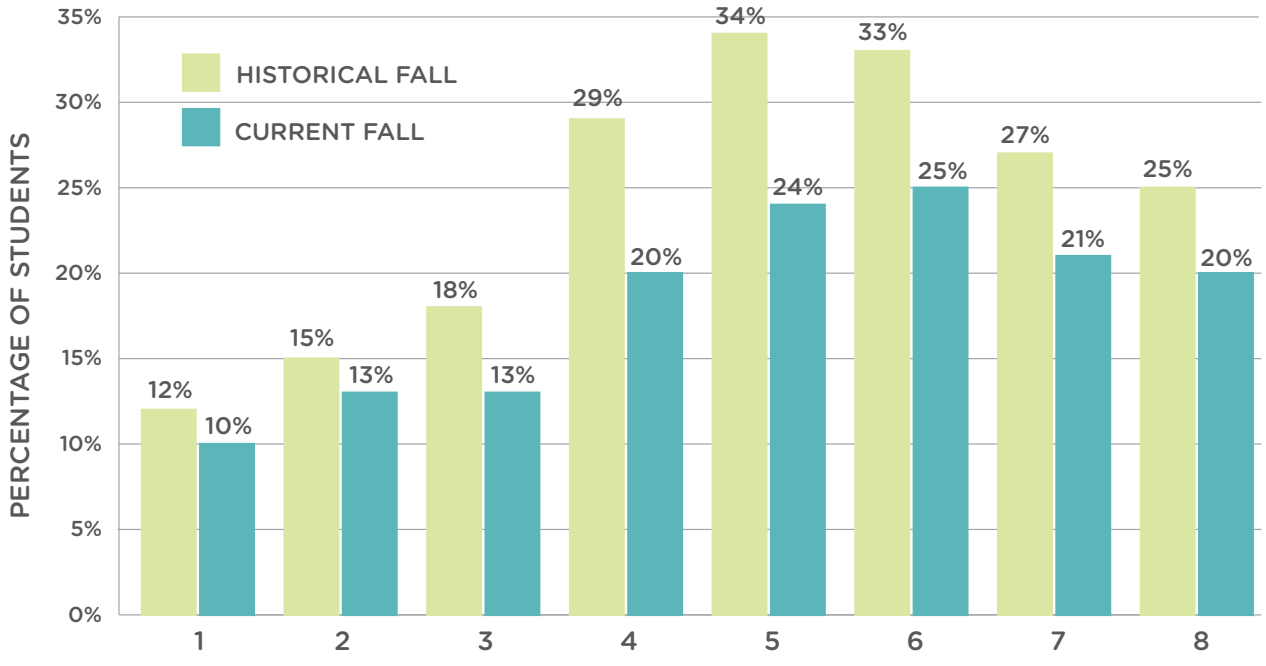
While the majority of students experienced academic setbacks, the pandemic has not affected all students in the same way or to the same degree. The conditions of education during the pandemic exacerbated longstanding inequities in learning for students of color and students in lower-income communities. Demographic data show fewer students in schools serving mostly Black and Latino students than White students and fewer students in lower-income zip codes started the 2021–22 school year on grade level.

Unfinished Learning in Math

Across our research and the most recent results from annual state assessments, one finding remains consistent: Students lost more ground in math than in reading. Why math? Students mostly learn math in school, especially as they get older. Parents are not as comfortable teaching math as they are reading to their children, and some math instruction does not translate as well to a virtual learning environment.

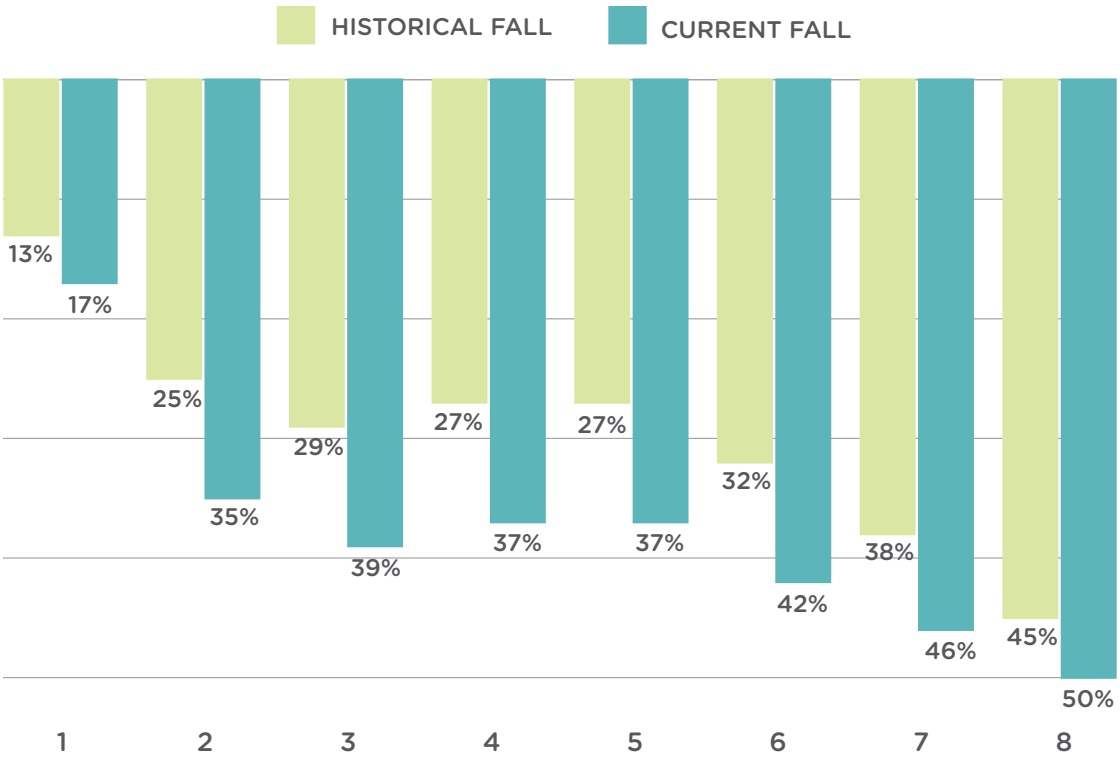
The findings from fall 2021 show that fewer

Figure 1. Grade 1–8 Students on Grade Level in Math, Fall 2021 and Historical Averages (percent)



Source: Curriculum Associates, "Understanding Student Learning: Insights from Fall 2021," Research Report No. 2021-17 (North Billerica, MA: Author, November 2021). The sample includes 3,331,943 students who took an i-Ready Diagnostic in math in school during the fall of the 2021–22 school year. The historical sample includes over eight million students who took the fall i-Ready Diagnostic in the previous three years in the same schools included in the current fall sample. Methodology, sample details, and study limitations are in the full report.

Figure 2. Grade 1–8 Students Two or More Grades below Their Chronological Grade in Math, Fall 2021 and Historical Average (percent)



Source: Curriculum Associates, "Understanding Student Learning: Insights from Fall 2021," Research Report No. 2021-17 ((North Billerica, MA: Author, November 2021). The sample includes 3,331,943 students who took an i-Ready Diagnostic in math in school during the fall of the 2021–22 school year. The historical sample includes over eight million students who took the fall i-Ready Diagnostic in the previous three years in the same schools included in the current fall sample. Methodology, sample details, and study limitations are in the full report.

students started the 2021–22 school year prepared to learn foundational math skills.[8] Fewer students in fourth grade were performing at grade level, and more students were performing two or more grades below, a 10 percentage point difference in fall 2021 compared with historical averages (figure 2).

We chose to highlight fourth grade here because students' ability to meet fourth grade benchmarks is a strong predictor of later academic success.[9] It is an essential grade to develop and master skills that prepare students for moving on to more advanced math, like algebra, that will be required throughout their secondary education.

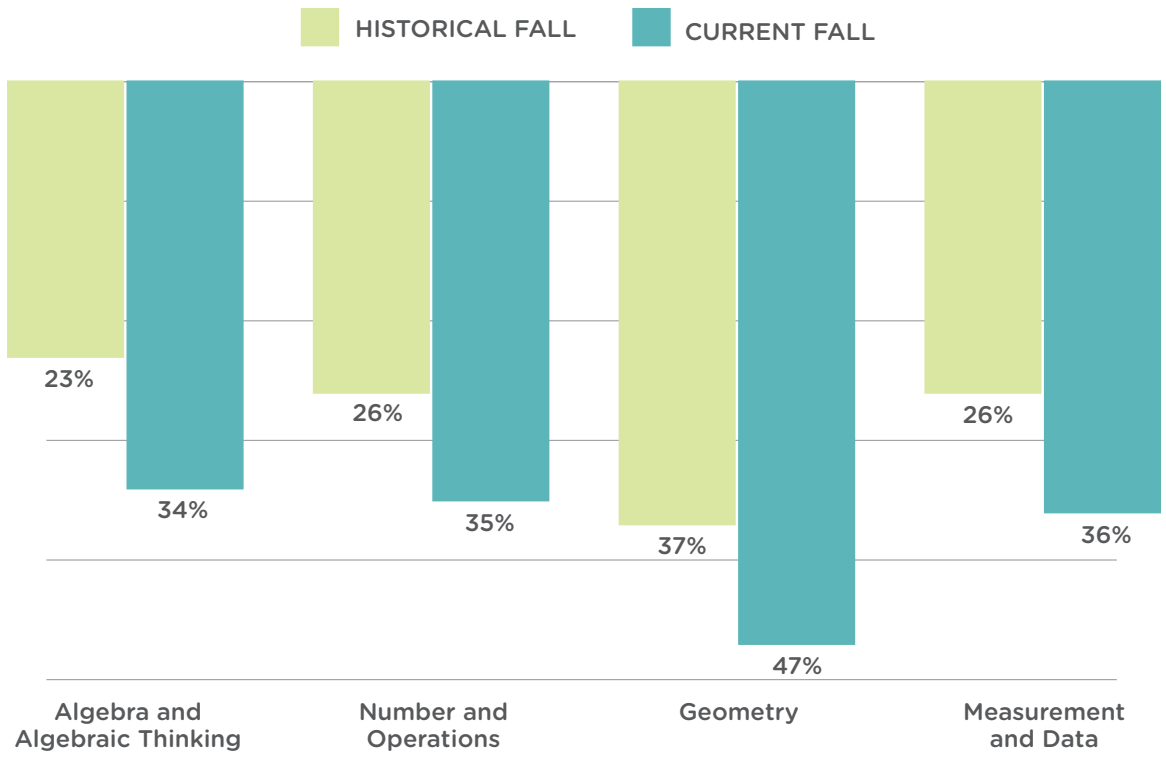
Simply looking at the overall numbers does not tell the whole story. As shown in figure 3, more students were struggling across the underlying domains at the start of fourth grade, which illustrates the depth of the issue: It is not just a subset of knowledge and skills that were affected but all math knowledge and skills. While only fourth grade data are shown, the same pattern exists across all grades.

Accelerating Math Learning

If a student misses a science class on cumulus clouds, for example, she will not necessarily struggle with the life cycle of a frog three months later. Likewise, teachers forced to skip a chapter on the War of 1812 do not have to scramble to catch up students before they begin the unit on the American Civil War. But what does "accelerated learning" look like for math,

It is not just a subset of knowledge and skills that were affected but all math knowledge and skills.

Figure 3. Grade 4 Students Two or More Grades below Their Chronological Grade by Math Domains, Fall 2021 (percent)



Source: Curriculum Associates, "Understanding Student Learning: Insights from Fall 2021," Research Report No. 2021-17 (North Billerica, MA: Author, November 2021). The sample includes 535,677 students who took an i-Ready Diagnostic in math in school during fall of the 2021–2022 school year. The historical sample includes 1,509,412 students who took the fall i-Ready Diagnostic in the previous three years in the same schools included in the current fall sample.

Great educators ask kids questions, over and over, until the missing step on the staircase reveals itself.

which at first glance might not appear to lend itself to acceleration?

Is it possible for educators to help students like Jaden catch up without stunting academic achievement by teaching content below his grade level? If so, what is a realistic, pedagogically sound way to confront unfinished learning?

There's one answer, and great educators already do it. They ask kids questions, over and over, until the missing step on the staircase reveals itself—until they have identified the specific foundational concepts that students are missing. Then they help students master those concepts while they are also learning the current year's material.

In the example of Jaden's sixth grade word problem, the goal of the lesson was to learn to create equivalent ratios, which can be done with multiplication and ratio tables. By pinpointing Jaden's missing foundational skills, his math teacher can tailor his instruction so he can answer the problem. That might mean reviewing how many ounces there are in a pound, reminding him how to create ratio tables, giving Jaden access to a calculator so he can convert ounces into pounds, or embedding a mini-lesson on conversions into the lesson, which serves the dual purpose of building Jaden's foundational skills while teaching him grade-appropriate material. The teacher and student can maintain the on-grade-level thinking of proportional relationships while not letting it turn into a lesson on division.

That's all. It does not require a new program or a radical approach to instruction. It requires teachers to identify skill gaps with precision

while also maintaining high grade-level ambitions for students with those gaps. Doing so allows teachers to close the gaps but also ensure that students can solve not only this year's math problems but also the ones to come.

Tutoring, afterschool programs, and new curricula can be effective tools for remediation, but the work to complete unfinished learning must begin in the classroom, with teachers discovering where their students need support and then building that support into the lesson. It requires that teachers have time, resources, and support from their school and district leaders to meet students where they are without compromising grade-level mastery.

Implications for Policy

The data on unfinished learning are alarming. It would be understandable if educators' first reaction is despair and their second is to ramp up remediation. But America's schools cannot remediate their way to equity, especially because COVID-19 exacerbated inequities that were already there. In addition, students who are furthest behind have not seen learning growth sufficient to make up for the initial disruptions and unfinished learning from spring 2020.[10]

In response to the widened learning gaps, states have vowed to accelerate student learning, and state education agencies have emphasized investments in programs and initiatives that will help students recover. For example, Arizona created the Acceleration Academies Grant Program to offer teachers added professional development in best practices in math and literacy instruction.[11] Virginia has committed its education department and school divisions to emphasizing "acceleration, not remediation."[12]

State policymakers have unique opportunities to help more districts, schools, and educators gain access to high-quality, on-grade-level, equitable math instruction through intentional, strategic support. Just as teachers must identify areas in which their students need the most targeted help, we recommend that state policymakers identify strategic actions that will lead to the most impactful changes for students.

- Accelerating instruction is not simply moving students through academic content or standards faster. It requires intentional decision making about what students must learn to be proficient in current and future courses. State boards can **make sure that states have processes in place to develop a shared understanding of essential math content and standards that engage teachers, content experts, and instructional leaders in decision making.**[13]
- States can **ensure that teachers have access to high-quality math curricula and resources that support just-in-time prerequisite support and acceleration to on-grade-level instruction.** States such as Louisiana, Texas, and Massachusetts are using state processes for review of curriculum materials to ensure that educators have access to high-quality materials. Their reviews outline clear expectations for curriculum materials and the materials' alignment to state academic standards. High-quality curriculum maintains coherence across grade levels and concepts and includes multiple access points for students.
- In order to best support students, states must **provide resources for and prioritize professional development that emphasizes deep math understanding, progressions of learning, and conceptual understanding.** Just as states have dedicated funding to additional professional development in the science of reading, states should consider additional funding to focus on deepening teacher understanding of math. States can leverage research on effective teaching practices that outlines strategies to support instruction no matter where that instruction takes place.[14]

In COVID-19's wake, many state boards are making critical decisions regarding many competing priorities. Research has brought into focus the true extent of the need. The data point to the glaring need for more focus on math instruction. In order to address students' needs for accelerated learning, decision makers must take into account the content areas, grade levels, and communities most in need of additional support. ■

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while offering innovative opportunities to get students ready for life beyond the standards.

Bonus: The state-level working of the system is so far removed from the general classroom that it is incumbent on state leaders to make extra effort to communicate and network with practitioners. ■

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