EDITOR’S NOTE
Math fluency requires understanding big ideas. This Spotlight will help you understand current math learning gaps; identify strategies for empowering students with mathematical thought; discover how to start students on the path of fluency; learn directly from teachers on how they’re giving learners the tools to solve the world’s puzzles; explore how early math supports can help vulnerable students; and more.

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Mathematical Thinking
Students’ Math and Reading Plummet, Erasing Years Of Gains, National Assessment Finds

By Sarah Schwartz

The pandemic brought historic declines in students’ math and reading abilities, with students who were already the furthest behind before COVID losing the most ground, according to new data from the nation’s only long-term measure of student progress.

The results, released today from the National Assessment of Educational Progress’ Long-Term Trend test, paint a stark picture of 9-year-olds’ achievement in 2022. Over the past two years, math scores dropped by seven points—the first ever decline in the long-term trend assessment’s 50-year history. Reading scores also fell by five points, the biggest drop since 1990.

“These results are sobering,” Peggy G. Carr, commissioner of the National Center for Education Statistics, which administers the NAEP, said in a call with reporters. “It’s clear that COVID-19 shocked American education and stunted the academic growth of this age group of children.”

These data confirm a chorus of other reports showing the academic impact of the pandemic. Interim test data from assessment providers and state test results have also revealed slackening or backtracking in student progress. But the NAEP long-term trend results are unique in that they provide a national snapshot that can be reliably compared to student achievement in years past.

NAEP’s long-term trend study is a separate test from the other subject-area assessments that students take. While NAEP’s main tests are updated regularly to reflect changes in standards and curricula, the long-term trend test has been relatively unchanged since it was first administered in the 1970s. That means it permits comparisons in students’ abilities across decades.

The last scheduled long-term trend test occurred right before the pandemic hit, in 2020. This administration was added for January through March 2022, in order to measure the effect that the COVID had on student scores.

However the data is sliced, the effects of the pandemic are clear: Many subgroups show declines in student scores. White, Black, and Hispanic students all saw drops in reading and math scores. Students across all regions of the country fell in math; students in every region except the West fell in reading.

“This report is disappointing, yet the factors contributing to the findings are not surprising given what the education landscape has looked like over the past two-and-a-half years,” said Dan Domenech, executive director of AASA, The School Superintendents Association, in a statement on Thursday.

But students who were already struggling before COVID hit saw the greatest drops in scores during the past two years.

This inequality in scores is consistent with trends that predate the pandemic. Long-term trend data from before COVID, released this past October, showed that the lowest-performing students were already losing more ground in reading and math than their higher-performing peers.

Other gaps expanded, too. White students’ math scores only fell five points, while Black students’ scores fell 13 points, widening the gap between the two from 25 points in 2020 to 33 points in 2022.

Still, some subgroups’ scores held steady over the past two years. There were no statistically significant changes in scores in either subject for Asian, Native American, or multiracial students. And in reading, students in cities maintained their scores while suburban students’ scores fell, narrowing the city-suburb gap. Reading scores for English-language learners also remained steady.

“These results are quite notable at this moment in time,” Carr said. “The fact that reading achievement among students in the cities held steady, when you consider the extreme crisis cities were dealing with during the pandemic, is especially significant.”

Lower-performing students had fewer supports during remote learning

In addition to student performance, the results also provide new insight into the conditions of remote learning during the 2020-21 school year. Students who took the test were asked about the support they had at home—and then researchers were able to show how that support differed for students who performed well on the assessment and students who performed less well.

The results show glaring inequities. For instance, among students who scored at or above the 75th percentile in reading—the high performers—83 percent said that they had
access to a desktop computer, laptop, or tablet all the time during remote learning. Among lower-performing students, at or below the 25th percentile, only 58 percent said the same.

These discrepancies persist across all of the categories that NAEP reported—from access to high-speed internet to having a quiet place to work to having a teacher available to help with assignments.

While suggestive, the results don’t determine a cause-and-effect relationship—from this data alone, it’s not possible to say that less access to support resources is what caused students to score lower on the long-term trend assessment.

But these results are in line with other data throughout the pandemic that has shown that students with the highest need were often the least likely to have access to reliable internet connection and space to work during remote learning.

“Decision-makers at all levels have not done nearly enough to address the long-standing resource inequities that prohibit Black, Latino, and students from low-income backgrounds from reaching their full academic potential,” said Denise Forte, the interim CEO of The Education Trust, in a statement on Thursday.

“And while there are decision-makers that are rightly pushing for equity and justice in schools, they are far too often met with fierce opposition from those who want to maintain the status quo.”

### Mathematics

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NOTE*: Stars indicate that the 2020 score is statistically different from the 2022 score

SOURCE: National Center for Education Statistics

### Additional Resource

To view the full chart data that accompanies this article, click [here](#).
Children learn best by doing.
That’s why we create teacher-developed, hands-on learning products. *Daily Math Fluency* is a supplemental math program that provides everything you need to teach and reinforce multiple strategies that build number sense. The powerful combination of Math Talks and Number Strings improve a student’s ability to think about numbers—building a strong foundation for future math success.

✅ Daily Math Fluency program covers grades K–8

hand2mind.com
These Early Math Supports Translated To Gains Later on for Vulnerable Students

By Sarah D. Sparks

Immediate academic gains from early-childhood programs often fade as children move into upper elementary school. But a new study suggests math supports in the earliest grades may build on each other over years to create longer-term benefits in math achievement and attendance.

In the latest report of an ongoing evaluation of the Making Pre-K Count and High 5s math programs in New York City schools, the research group MDRC found neither program on its own led to significant, sustained math gains by 3rd grade. Yet students who participated in both the preschool and the kindergarten interventions performed significantly better in math and were less likely to miss school by grade 3, compared with students who did not participate.

In the study, students in 2013-14 were randomly assigned within their public schools to participate in standard preschool and kindergarten or the preschool math curriculum alone or with High 5s, a kindergarten enrichment program in which math tutors each met with three to four children for 30-minute “clubs” three times a week, either during a free period or outside of school.

The enrichment sessions focused on games, songs, and other activities to help students practice geometry, pattern recognition, and other math concepts, rather than basic counting drills in the standard classes.

Shira Mattera, the study author, said the results suggest “the effects seem to be particularly pronounced for children with the most room to grow.”

Students who started preschool with lower-than-average language and attention skills showed math gains by 3rd grade equal to a quarter to a third of a standard deviation. Two years of math enrichment in preschool and kindergarten were enough to produce 3rd-grade math gains large enough to close about 40 percent of the math performance gap between low- and high-income 4th graders.

Attendance improved for participants

Moreover, the researchers found that 28 percent of the students who participated in two years of math enrichment were chronically absent—meaning they missed 10 percent or more of school days—in grade 3, compared with 37 percent of 3rd graders who had not received the early math services.

While chronic absenteeism in early grades often comes from family challenges and stressors that the study did not measure, the researchers did offer some speculation about why students who received math enrichment missed less school later on, Mattera said.

“In kindergarten, in our earlier years of analysis, we found effects of the programs on children’s attitudes towards math. Perhaps, how kids either viewed school or viewed math might have influenced whether they wanted to come to school,” she said. “It’s also possible that teachers saw children who were doing better in math or liked math better as more engaged,” and so built better relationships with them.

These academic and attendance benefits may be particularly important for school districts working to catch up large cohorts of students who are now entering preschool with less formal early-childhood education as a result of the pandemic.

“Both of these programs build on learning trajectory development. All children develop math abilities on a general developmental sequence,” she said. “If you understand the skills that are associated with that sequence, you identify activities that are appropriate for meeting the child’s needs and learning goals to move them to the next part of the sequence.

“I think it makes a nice addition to how people can think about the wide range of skills that children will be coming in with after COVID, because while some students may be coming in with lower skills, because they’ve had missed opportunities, some children may have had a different set of opportunities and teachers are really going have to differentiate across that,” she said.

“And this gives an entre into thinking about how you could use similar math activities to meet the needs of a wide range of children’s skills and experiences.”

Published December 10, 2021
Textbooks Need More Real-World Math Exercises, Study Finds

By Sarah D. Sparks

A typical 8th grade math textbook includes just a handful of real-world problems for students to solve, finds a new international study.

And that’s not enough, according to William Schmidt, distinguished professor at Michigan State University. “It’s not enough anymore to just teach the kids the fundamental skills, but to move toward being able to reason with those to solve real-world examples,” he said, “because the textbooks simply do not provide enough opportunities for students to actually practice applying mathematics in real-world applications. And I think that now is a major issue confronting American education in math.”

Schmidt led the analysis of 50,000 math exercises from the 8th grade textbooks of 19 countries, including the United States, by researchers working on behalf of the Organization for Economic Co-operation and Development’s Future of Education and Skills 2030 project. The researchers found less than 150 student tasks in all dealt with higher-order, real-world applications of math. In the United States, such problems accounted for just over half a percent of all problems, or seven.

The Mathematics Curriculum Document Analysis study follows up a similar study in 1995, which looked at the content and coherence of topics covered in grades 1-12 in the math standards of more than 40 countries that participate in the Trends in International Math and Science Study.

Compared to 25 years ago, Schmidt said, U.S. math standards have become more in line with other top-performing industrialized countries. “It’s a much, much more coherent structure and reflects the logical structure of mathematics,” Schmidt said, “but the question is what textbooks are chosen because we have lots of choices—I think at one point we had 20-some different versions of an 8th grade math book—and some of those books have not caught up with the change in the standards.”

The 2022 audit focused on textbooks because prior studies found that while teachers do add their own lessons, the majority are overwhelmingly likely to follow the content of the textbook—and this was particularly true during remote instruction, Schmidt said.

The United States, like other countries, has increased its coverage of statistics, geometric, and algorithmic reasoning, higher-order real-world applications, and 21st century competencies such as communications and creativity in math.

But the study also looked at the kind of exercises that were included: purely computational, either in numbers or standard word problems; higher-order math problems that require identifying a problem and logical progression; and real-world higher-order problems, that situate those higher-order problems in realistic contexts.

Worldwide, 85 percent of textbook exercises were purely computational, checking students’ ability to multiply, divide, and so on. In the United States, just over 68 percent of math exercises were computational, with about 29 percent of them being word problems and fewer than 3 percent involved higher-order math that was not situated in real-world problems, such as a geometric proof in which students must identify relevant information and develop a logical process to solve it.

But the word problems often ended up as...
“really computational problems with words around [them]” Schmidt said. “So instead of asking what’s 6 plus 2, they say Jill has six apples, Sally has two; how many do they have? And then that’s considered to be an application. When we look across these countries, we only found a little over 100 out of all 50,000 [math exercises] that would actually expect children to take their math and apply it.”

The study, released this spring, comes amid ongoing concerns about U.S. students’ decline in math performance in both national and international assessments. The United States’ use of real-world, higher-order problems has varied more widely than those of other high math-performing countries, even though students perform roughly on par with global averages.

**Realistic problems can engage students**

More-realistic math problems offer the opportunity for more class involvement, too, Schmidt argued.

For example, one Hungarian exercise set out a family of four who lived within driving distance of a ski resort. Students were asked to help the family decide, based on the travel distance and the price of gas and hotel, whether it was more cost efficient for the family to spend their vacation driving each day to the slopes or staying at the resort. The students then could work through how the costs might change for their own families, he said.

“With this kind of question, the issues are more around the reasoning and the development of the problem, and thinking through how to use that mathematical set of knowledge you have to solve something that’s important,” he said. “Yeah, the end is you have to compute something, but it’s learning to think through, lay out the logic, realize what you need to do to figure out the answer to your question. That’s really what the world is about. That’s what all of us need to be able to use as serious adults.”
**Daily Math Fluency** A RESEARCH STUDY

**Impact on Student Learning**

- 91% of students demonstrated improvements in Problem Solving
- 91% of students demonstrated improvements in Fluency Speed
- 83% of students demonstrated improvements in Math Talk
- 91% of students demonstrated improvements in Fluency Accuracy

Data collected through classroom observations and survey responses of 12 pilot teachers

85% of students scored significantly higher on their fluency posttest in comparison to their pretest.

**Daily Math Fluency** Bridges the Gap for Learners with Special Needs

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<th>Category</th>
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Average Percentage Point Gain from Pretest to Posttest
N = 130 (Non IEP), N=36 (IEP)

**Daily Math Fluency** Delivers Consistent Results Among All Ethnic Subgroups

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<td>Other</td>
<td>70</td>
<td>80</td>
<td>+30%</td>
</tr>
</tbody>
</table>

N = 76, African American N = 57, Hispanic N = 19, Other N = 12

**The Teacher Experience**

- **Mr. Hargett**, 1st Grade Teacher
  - Daily Math Fluency enables all teachers, regardless of experience, to teach useful strategies that are beneficial for student learning.

- **Mrs. Ward**, 1st Grade Teacher
  - I believe Daily Math Fluency is an engaging routine that all math teachers should be implementing. My students love these routines, and it is a wonderful way for students to share their math thinking in a safe environment.

- **Mrs. Pugh**, 4th Grade Teacher
  - Daily Math Fluency enables all teachers, regardless of experience, to teach useful strategies that are beneficial for student learning.

- **Mr. Hargett**, 1st Grade Teacher
  - We have a need for flexible and efficient math thinking in the early grades. This will lead to strong mathematical thinkers in the upper grades.

100% of teachers say Daily Math Fluency should be in every classroom in Alabama.

100% of pilot teachers see increase in test scores.

**Non IEP**

- 33% of my students’ test scores increased
- 66% Most of my students’ test scores increased

Visit [hand2mind.com/resources/AMSTIresearch](http://hand2mind.com/resources/AMSTIresearch) to read the complete research study!
To Enliven Lessons, Teachers Bring Social Justice Into Math Classes

By Elisha McNeil

From incorporating rap into lessons to using the “Hejný method,” educators are increasingly looking for creative ways to make math more interesting to students and more applicable to “real-world” situations.

One of the latest trends is “social justice math,” a teaching style that combines math with political, economic, and social issues as an alternative way to try and involve students by relating materials to their communities and personal lives.

Transforming the learning experience by incorporating social justice into the classroom is how one algebra teacher at South High School in Minneapolis, Minn. is drawing students into math, while also helping them better understand issues regarding injustice and inequality in society, according to the Minneapolis Star Tribune. Through crime statistics and data, Stephanie Woldum tries to engage her class by connecting math to community issues. Students in Woldum’s class collect various social data about Minneapolis neighborhoods that lead to questions about race, income, crime, and policing. They then use statistical methods to analyze the data, and present answers.

“They don’t ask, ‘Why do I need to understand this?’ They don’t ask me how they are going to be graded {...} Their focus is on the learning.”

STEPHANIE WOLDUM
High school teacher, Minneapolis, Minn.


A recent self-study by Lisa Harrison, an assistant professor at Ohio University, suggests that social justice math can be a new learning experience for teachers, too. For “Teaching Social Justice Through Mathematics,” Harrison reflects on her time as a guest teacher at a 7th grade class that integrated social justice and math. Not only did she find positive transformations within the students; she said her own understanding of social justice issues was also challenged.
As a mathematics educator who also happens to be a new mom, I have serious concerns about the future math classroom my daughter will enter. One of my biggest fears is that the math class will stifle much of her curiosity and creativity that I have witnessed every day during her first few months of life.

In my collaborations with preschool to 2nd grade early-childhood educators over the past five years, I have found that teachers often wrestle with two historically competing philosophies of educating young children. One philosophy embraces the importance of creating play-based environments, where children learn by exploring and engaging in play. The other emphasizes the need to prepare students to meet state and national mathematics standards by focusing on specific academic skills. These two philosophies are not either-or. In fact, mathematical thinking and learning often happen during play.

With the adoption of the Common Core State Standards and an increasing focus on so-called 21st-century skills, our thinking about supporting students’ curiosity and creativity has progressed in recent years. However, as with most change, the implementation of our ideas hasn’t yet panned out the way we might have hoped.

I am finding that teachers are increasingly feeling the pressure to address learning standards in ways that do not build upon young children’s inherent curiosity and inclination to experiment. Math instruction in the early grades is too often becoming more like traditional high school math classes. I have seen kindergarten and 1st grade teachers giving short lectures followed by having children complete worksheets filled with math problems. These worksheets often consist of the same type of problem just with different numbers (e.g., \(1+2 = \_\); \(1+3 = \_\); \(1+4 = \_\)) and noninteractive images for young children to count or compare.

What I am witnessing is not surprising given our misconceptions of what it means to learn math in school. Many think that math is all about learning procedures and memorizing rules. At both the high school and elementary levels, procedurally focused learning is not conducive to supporting students’ understanding of important mathematical concepts. In fact, a 2016 study published in Scientific American found that students who rely on memorization are half a year behind their peers who approach math by relating concepts to existing knowledge and monitoring their own understanding.

It is important to attend to mathematical learning goals while fostering creativity early in a child’s education. We need to create more opportunities for young children to explore mathematical ideas in interactive and playful ways. Instead of doing math worksheets, young children need intentionally designed activities that allow them to think and engage like mathematicians by testing out different ideas, experimenting with strategies, and explaining their thinking. Unlike traditional math worksheet problems that can only be solved one way, children should engage in problems that have many possible solution strategies and are ripe for discussion.

“We need to create more opportunities for young children to explore mathematical ideas in interactive and playful ways.”

**KATHY LIU SUN**
for discussion and debate.

What can we do as educational practitioners and leaders?

1. **Be curious about how children think.**

   Young children have fascinating strategies for how to solve mathematical problems. Our goal is to support them to develop perseverance, confidence, and critical thinking skills when solving math problems. Rather than telling them exact steps for solving a problem, a good first step is to ask open-ended questions (“How did you figure it out?”). Then watch to see what the child does before asking another question that is based on what you observed (“I noticed that you moved the blue bears. Why did you do that?”).

2. **Support teachers to change things up.**

   Teachers should be encouraged to focus on the creative nature of math. It’s OK if math assignments don’t look like traditional math worksheets. If teachers give homework, it should be interactive and exploratory in nature, not stagnant worksheets.

3. **Get parents on board by encouraging them to find opportunities to engage in math in our everyday lives and surroundings.**

   A great way to start is by counting collections of objects with young children. A collection can be made up of anything found at home, such as coins or utensils. The goal is to figure out how many objects are in the collection and to support children to think deeply about quantity in a way that makes sense to them. In my experiences, children are very excited to figure out how many objects are in their collections and will use a variety of strategies in the process (e.g., sorting, multiplying, adding, etc.).

   If we make a concerted effort to push back against traditional math worksheets, my concerns might be alleviated by the time my daughter enters kindergarten.

Kathy Liu Sun is currently an assistant professor of education at Santa Clara University, where her research examines the barriers that prevent students from succeeding and advancing in mathematics and STEM-related fields. She previously taught high school math in San Jose, Calif.
Daily Math Fluency Positively Impacts Students and Teachers

Research in the last decade reveals that the highest achievers in math are those who focus on big ideas and the connection between ideas. When students have an intuitive understanding that numbers are comprised of other numbers that relate to one another, they possess the foundation needed to conceptualize relationships in numbers and solve more complex mathematical equations and problems.

Daily Math Fluency was developed by hand2mind as a direct result of the gap in math fluency. It provides teachers with a complete toolkit that uses Number Strings and Math Talks as well as the most relevant math demonstration manipulatives so they can help students develop the skills they need to solve mathematical problems and conceptualize the relationship between numbers instead of relying on memorization.

Impact on Student Learning

Overall results indicate Daily Math Fluency had a positive impact on test scores of students participating in this pilot.

- 22.4% percentage point gain
- Over 85% of participating students demonstrated gains

Results by subgroup highlight the flexibility and efficacy of Daily Math Fluency across classrooms and demographics.

- Female students demonstrated a larger percentage point gain (+24.1%) than males (+20.1%), and they surpassed the male students in the average absolute posttest scores.

Pilot Summary


- The pilot consisted of an experienced teacher at each grade level as well as a novice/teacher at each grade level.

- A pretest/posttest design was used to capture the impact of Daily Math Fluency on grade-level fluency assessments outside of the program.

- A total of 12 teachers submitted data for 171 students.
Impact on Student Learning continued

• Students demonstrated similar gains across all races ranging from 20.1% to 30.5%

Percentage Point Gains by Race

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<th>Race</th>
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<td>+29%</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>+30%</td>
</tr>
</tbody>
</table>

N=76, African American N = 57, Hispanic N= 19, Other N=12

• Of the 21% of students with an IEP, the average gain was 24.4%. The average test score gain of the 76% of non-IEP students was 21.5%.

• Students who had lower pretest scores showed similar gains as those students with higher pretest scores.

• Of those participating, 100% reported that either some (33.3%) or most (66.7%) of student fluency test scores increased.

• When asked which components students demonstrated improvements in, 91.6% of the teachers stated fluency accuracy, 91.6% stated fluency speed and problem solving, and 83.3% stated verbal communication in math.

Conclusion

The AMSTI Pilot Project provided valuable information on the efficacy and use of Daily Math Fluency in the classroom. The evidence from the pilot demonstrates that the program provides support for students to increase their understanding and ability to comprehend mathematical concepts—including the most vulnerable learners. Daily Math Fluency positively impacts the classroom experience of both students and teachers.

Teacher Experience

• The 12 pilot teachers rated Daily Math Fluency a 4 out of 5 on ease of use with 5 being the easiest.

• 100% of teachers surveyed think Daily Math Fluency should be in every classroom in Alabama, and 100% responded that they liked using the program.

To read the complete AMSTI Pilot Project Study, go to: hand2mind.com/resources/AMSTI-research
We Should Teach Math Like It’s a Language

By Jeannine Diddle Uzzi

The United States has a math problem, and, like most middle school students sitting down with their homework, we are not finding any easy solutions. Young people in this country are struggling to attain the proficiency necessary to pursue the careers our economy desperately needs. Universities bemoan students’ inability to complete college-level math. Each year thousands of newly admitted college students are placed in non-credit-bearing remedial courses in math, a path that immediately puts them at a higher risk of not completing a degree.

Maybe it’s the classics professor in me talking, but I approach this math problem from an unorthodox angle: Latin. In a 2011 article, “An Apology for Latin and Math,” high school Latin teacher Cheryl Lowe made a compelling comparison between the study of Latin and the study of mathematics. Much like Latin, she observed, “math is hard because it builds so relentlessly year after year. Any skill not mastered one year will make work difficult the next.”

High school teachers have discovered that the unrelentingly cumulative nature of the study of Latin and the study of mathematics explains why students struggle to excel in either discipline.

A high school student is often not as prepared as a college student to confront demanding theoretical material, and therefore college classes might incorporate more theory than would a high school class.

Students who took Latin in high school are often encouraged to begin Latin anew when they get to college. The review students receive in an introductory college course reinforces their learning in preparation for more advanced work. This is precisely what I did when I got to college, and no one suggested that mine was not college-level study, quite the opposite: I became a classical languages major and nine years later finished a doctorate in classical studies.

In contrast, the United States has been sucked into the myth of college-level math. If students need a review of algebra, instead of encouraging them to start anew in order to reinforce their skills, we test them, label that review “remedial,” and withhold college credit from them. This message is jarring and discouraging to new college students, many of whom already have significant doubts about whether they belong in college or whether college is worth the investment.

I point out the discrepancy between our approaches to these subjects not to downplay the national crisis in quantitative reasoning but to suggest that the deficiency is in our attitude toward teaching math.

We know how to teach Latin, and we do it well. Year after year we teach the same challenging skills, facts, and concepts in different ways from middle school through college, never complaining that students are not doing college-level work. Once students have enough facility to read unabridged ancient texts, whether that happens in 8th grade or their junior year of college, we move on to translation and critical reading appropriate to the developmental level of the student.

Our approach to teaching Latin can inform
better practices in math education. No one would deny that students wishing to become physicists must master calculus, but we must shift our narrative from one that labels students “deficient” on the basis of arbitrary grade-level designations. Instead, we should embrace a reverse-engineering model in which we establish clear, carefully constructed pathways to the things students must do.

Our lamentations about student deficiencies and our focus on what constitutes college-level work have been an unfortunate distraction from the salient challenge of how to help students reach the careers or paths of study to which they aspire. Meeting this challenge may require blurring the lines even further between high school and college curricula. It may require courses of different paces and configurations from the familiar K-16 standards. It will certainly require better partnerships between high schools and universities.

As is so common in the academy, we have focused on faculty-centric, content-based questions (“What constitutes college-level math?”) rather than student-centric, learning-based questions (“What do students need to reach their goals?”). Solving our math problem will require unorthodox strategies for increasing student success in math rather than trying to quantify what “counts” at the college level.

Jeannine Diddle Uzzi is the provost and vice president for academic affairs at the University of Southern Maine.
How to Bring Math Into Students’ Real Lives

By John Urschel

When I was a kid, I hated math. I thought it was boring and a waste of time. I hated memorizing rules that didn’t seem to connect to anything in real life, and I couldn’t stand doing hundreds of exercises. The feeling was mutual; my math teachers were not particularly fond of me.

At home, my mother and I would spend hours doing puzzles and competing to see who could solve them first. If I won, I would get a dollar toward my allowance. I loved puzzles, not just because they were how I made my money, but because they were fun and challenging. I could feel myself improving. Very quickly, my mother had to change the rules of the game because I was becoming quite the little tycoon!

I had no idea that what I was doing with my mother was actually math. It wasn’t until I got to college that I realized that mathematics is not just memorizing formulas in a classroom, but is actually more closely related to what I was doing with my mom as a kid. Math gives us the tools to solve the world’s puzzles.

As a doctoral student in mathematics at MIT, I feel the same rush and joy when I’m working on a hard proof or problem as I did back in my mother’s kitchen as a kid. It doesn’t even feel like work. As with football (a sport I play professionally), it fires my competitive instincts—only in math, the competition comes from math problems that many have tried to solve and failed. Unlike a game, there is nothing unnecessary about it. The work I’m doing relates to everything from artificial intelligence to dealing with massive amounts of data.

One of the most challenging things we face is getting students excited about math and science. Building a strong foundation in math and science is critical to help set students up for success in the classroom, in college, and beyond. Math education isn’t just about solving problems in the classroom; it’s an exercise in training to help students solve the problems they will face in life.

To show kids that math is rooted in real life—and that it can be fun—I’ve recently partnered with the technology company Texas Instruments to explore the “STEM behind sports” in a new program. The program consists of a series of activities that allow students to explore the science, technology, engineering, and math behind some of their favorite sports. In one activity about football, students must use math and science to investigate the path of a field-goal kick in order to win the game.

I want students to see that math extends far past the confines of the classroom and into everyday life. I also want them to appreciate that math is cool. In fact, the older I’ve gotten, the more I’ve found that when people want to talk about what I’m doing, they don’t want to talk about football. They want to talk about math. Even my teammates think it’s interesting.

Math isn’t just about calculations or memorizing formulas. Math is everywhere we look. It’s in the science behind a perfect football spiral, the velocity of a game-winning three-point shot in basketball. It’s in the ratio of ingredients you measure when you’re cooking. It’s even in how you budget to save for your first car. When I was a kid, I didn’t realize that math was training my brain to solve these types of problems.

Every day, we make hundreds of decisions that are informed by our quantitative judgment. Most of the time, we don’t even realize it. When you’re packing a lot of things into a small bag, you have to think geometrically. When you’re planning a schedule or dividing your time, you’re thinking quantitatively. When you’re trying to decide between two different options, you’re thinking analytically.

As a kid, I had no idea that I would become a mathematician. But in some sense, everybody has to become a mathematician. We all face problems that require mathematical concepts. The better we can solve them, the better off we’ll be.

I want students to see that math extends far past the confines of the classroom and into everyday life.”
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