EDITORS NOTE
Educators around the country are adopting innovative strategies to teach math in a remote or hybrid environment. In this Spotlight, discover how teachers are encouraging math discourse with students, teaching math to students with disabilities, and easing students' anxieties toward math.

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Getting Students to Talk About Math Helps Solve Problems

Having students put their math thinking into words engages more students and boosts achievement, proponents say

By Catherine Gewertz

Getting students to talk about their thinking process in math can give teachers insight into where they need help. But it’s also a potentially powerful equity strategy, experts say.

And as teachers learn how to move instruction online because of the coronavirus, they’re all too aware of the equity issues involved: Some students have computers and good internet connections, and others don’t. Some have parents who can help with schoolwork, and others don’t. In that situation, teachers wonder how they can manage to reach all their students, let alone how they can create a class conversation about students’ math thinking.

The good news, according to experts, is that math discourse is a technique that works as well virtually as it does on paper or in face-to-face classrooms. And now, when students and teachers risk feeling disconnected and adrift, there’s even more reason to consider using “math talk” techniques to help students feel engaged and see themselves—and their classmates—as valued mathematical thinkers.

Dawn Carl, the superintendent of the Winship-Robbins Elementary school district in Robbins, Calif., started focusing intently on a range of math-conversation techniques two years ago, when the English-language learners at the district’s one school, a K-8, dropped 12 points on state math tests.

But it turned out that the techniques helped all students in the school. English-learners improved their proficiency rates by 5 percentage points between the 2017 and 2019 test administrations, and native-English speakers increased theirs by 7 points, Carl said.

“It’s really made a difference for us,” she said.

The idea that “math talk” can have academic payoffs isn’t new. Research studies have described the benefits of discussing mathematical thinking for decades, and the idea crops up in a stream of publications from the National Council of Teachers of Mathematics dating back 40 years, said Robert Q. Berry, the immediate past president of the organization.

But math discourse got a boost in 2010, when the new Common Core State Standards put a high priority on ensuring that students understood the concepts underlying their calculations. Mastery of the common core’s standards for “mathematical practice” means students must know how to do things like construct viable arguments and critique others’ reasoning.

“These aren’t new ideas, but they’re practices many teachers have been working on,” Berry said. “Good math talk can help students with math sense-making.”

Here are four ways that experts Education Week consulted—researchers and practitioners—suggest you can help your students build their “math talk” muscles.

1. Create a culture that welcomes “rough draft” thinking.

Amanda Jansen, a professor of mathematics education at the University of Delaware, argues that sharing rough drafts in math can serve two powerful purposes at once: It can deepen students’ understanding of math ideas and practices, and it can create an equitable learning environment.

Here’s one way to do that, and it can work as well remotely as it does face to face, she said. Students write a first draft of a solution to a math problem. They log into Zoom and review a
Early Math in the Home Matters for Later Skills

By Sarah D. Sparks

Parents have gotten the message that reading with their children can help instill lifelong literacy skills. A new study adds to the evidence that parents can be providing the same boost to numeracy skills by making sure their preschool children have an enriching math home life, too.

A new study in the journal *Child Development* tracked nearly 370 Spanish-speaking Chilean children and their families over two years, from the start of preschool through the end of kindergarten. Regardless of families’ socioeconomic background, the study found preschoolers whose parents gave them frequent opportunities to do simple math problems and games at home showed better arithmetic growth and performance by the end of kindergarten than children with less-engaging early math environments at home.

Their parents, mostly mothers, had educations ranging from less than a high school diploma to four-year university graduates, with most at a community college level. The parents relayed how often they played a variety of activities at home:

- **Mapping activities**, such as reciting numbers, singing counting songs, or recognizing printed numbers;
- **Operational activities**, such as simple adding or subtracting, telling time using clocks or calendars, and measuring; and

The children were tested in several key math and literacy skills at the start and end of preschool and kindergarten, including verbal and object

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Edited by Sarah D. Sparks
counting, identifying numbers, problem-solving, math vocabulary, arithmetic fluency, and placing numbers on a number line, among other tasks.

The researchers found, as in prior studies, that parents tended to have higher expectations for their children in reading than in math, and favored literacy over number activities. Better-educated parents recognized more commercial math games than less-educated parents did.

After controlling for the children’s initial math skills and their parents’ education, the researchers found basic “mapping” number activities were not associated with later math growth, but the time preschoolers spent playing more advanced “operational” number games with their parents predicted their growth and math performance by the end of kindergarten. In particular, frequent home activities were linked to better skills in comparing numbers and arithmetic fluency.

Some math and literacy activities also seemed to support each other. For example, frequent operational math activities such as addition and subtraction were linked with better vocabulary knowledge and letter-word identification, and code-based literacy activities such as identifying letter-sounds was associated with symbol-related math skills, such as arithmetic fluency.

The study adds to evidence of the importance of schools engaging parents in children’s math education as early as reading.

It generally takes until preschool age for children to understand that a word like “four” represents a set of items, but prior studies have found infants and toddlers can understand concepts like counting much earlier, and playing math games improved their number sense over time. Similar studies have found that parents who regularly talk to their toddlers about math and numbers have children with significantly higher math knowledge by the start of preschool.

Perhaps equally important, studies have found that rates and severity of math anxiety increase in children as they age, in part because they tend to be exposed to more fear or other negative attitudes about math from parents and society at large over time. But when parents and kids have frequent opportunities to play math-related games and puzzles together, prior research suggests both generations build up better math skills and more positive associations with the subject.

To increase the number of students entering math and science fields, it’s not enough for them to perform well in math. They have to enjoy it enough to make it a big part of their lives.

New research suggests anxiety can make students avoid engaging in math, even when they could gain big rewards from doing so. But a separate study also offers one simple way teachers can help math-anxious students build their confidence with the subject.

In a series of studies described in the journal Science Advances, researchers from Columbia University, the University of Chicago, and Stanford University asked nearly 500 adults to choose between attempting easy questions for a small reward for each correct answer or challenging questions for bigger correct-answer rewards, in both math and reading.

Participants who had higher levels of math anxiety before the task were as likely as anyone to choose challenging word problems, but they were significantly less likely to try difficult math questions, even for three times the reward, the researchers found. The differences remained even after researchers controlled for differences in the participants’ accuracy, suggesting that the participants favored easy math problems not because they were unable to solve difficult problems, but because they were reluctant to try. In fact, the researchers also found that the higher someone’s math anxiety, the less time he or she spent trying to answer difficult math problems at all.

This can start a cycle of anxiety and avoidance, said Sian Beilock, a co-author of the study and the president of Barnard College at Columbia.

“You could imagine it playing out in the math world that if you don’t feel like you’re good at it or you’re anxious about it, then you devalue it.”

SIAN BEILOCK
PRESIDENT, BARNARD COLLEGE AT COLUMBIA
Students with math anxiety often choose to take fewer math-related courses and consequently pursue fewer STEM-related occupations than their less-anxious peers,” Beilock and her colleagues concluded. “By tackling math avoidance early, we may be able to break this vicious cycle before critical academic and occupational choices are made.”

The findings come as educators and policy makers work—so far with mixed success—to increase the number of girls, students of color, and low-income students entering math and science careers.

U.S. girls and low-income students are significantly less confident about their ability to apply math, and at higher risk of math anxiety, than boys and wealthier students. Even as girls in this country closed the math achievement gap with boys in the PISA from 2003 to 2018, their lack of confidence, compared with boys, didn’t change significantly; in fact, in the most recent PISA, only 1 in 10 top-performing girls in math said she wanted to go into a STEM field, compared with 3 in 10 boys.

Prior studies suggest math instruction that focuses on memorizing processes and answering quickly can heighten anxiety. “You know, there are many ways to do a math problem,” Beilock said. “And if [math is] being taught in a way where you’re not able to pull any of that creative joy out of it, that makes you kind of step away.”

A separate study of Dutch children out this week in the journal *Child Development* suggests that teachers may help students gain confidence in math by helping them focus on their own goals for effort, not math ability.

Researchers asked more than 200 students in grades 4 to 6 about how competent they felt in math. A few days later, all took the first half of a standardized math test, and then were randomly assigned to do nothing or to participate in one of two “self-talk” exercises. One focused on their math ability—such as repeating, “I am very good at this!”—while the second group focused on their effort in math, saying, “I will do my very best!” After the interventions, all three groups took the second part of the math test.

There were no significant differences on the first and second halves of the test for students in the control group and those who engaged in talk about their abilities. But students who coached themselves on effort improved afterward.

In interviews with Education Week, experts—practitioners and researchers—offered perspectives on how to make mathematics instruction best serve those student populations. Their advice clustered around three themes:

- Resist the temptation to de-emphasize language in math class, especially for English-learners and those who have language-related disabilities. De-emphasis is probably a disservice.
- Consider how broad student labels can conceal mathematical skill. English-learners, depending on their prior schooling, and students with disabilities, depending on their specific disability, can have widely varying math abilities and knowledge.
- Consider how to teach with excellence in mind. Excellence in teaching math means that students are engaged and challenged, and that they have the opportunity to succeed.

When students are English-learners or have learning disabilities, it’s especially important to focus on their strengths.
Building a Foundation for the Essential Learning of Mathematics: Flexibility with Numbers and an Understanding of Computational Strategies and Algorithms

Current standards typically call for students to develop computational skills based on physical and visual models, place-value-linked strategies, and mathematical reasoning. In other words, students are expected to know how to figure out the answer (and why that method works) rather than simply memorizing facts on flash cards. This emphasis on reasoning and connecting mathematics procedures with concepts builds a strong foundation for understanding operations with greater whole numbers, common fractions, and decimal fractions later in elementary school, as well as a strong foundation for algebraic reasoning in secondary school. As such, it is critical to get this right.

These standards are driven by research findings which support the connection of concepts with procedures and the building of strategy-based understanding of basic facts and algorithms. NCTM’s Effective Teaching Practices (NCTM, 2014) include building procedural fluency from conceptual understanding. The findings of a number of researchers also support the idea that students build fact fluency through understanding number relationships and principles, not by rote memorization (Baroody, Fell, & Johnson, 2007). Adding It Up, the National Research Council’s 2001 seminal publication on how children learn mathematics, supports this same idea that fact fluency is important, but recall of facts should be based on understanding of the operations and thinking strategies. Procedural fluency includes four components: accuracy, efficiency, appropriate strategy selection, and flexibility (Kilpatrick, et al., 2001; NGO & CCSSO, 2010).

In addition to this specific research base on building fluency, there is a broader research base on using a Piagetian developmental approach to teaching mathematics by working across concrete, visual, and symbolic representations. Elementary mathematics teachers often have and use physical manipulatives as concrete representations of mathematics. They may not have access to a wide range of visual representations, which often serve as a powerful connector to symbolic representations. It is important for deep learning that students not only use the various representations, but also connect them (Hattie, et al., 2017). Using and connecting multiple representations is another one of NCTM’s effective teaching practices (NCTM, 2014). This Piagetian approach has a very high effect size (1.28) in the Visible Learning database (Hattie, et al., 2017).

Join our community to receive ideas and resources that foster mathematics learning: origoeducation.com/community
Building a Foundation for the Essential Learning of Mathematics:
(continued)

ORIGO Education’s *Book and Box of Fact Strategies* resource teaches all four operations (addition, subtraction, multiplication, and division) from this perspective of connecting procedural fluency to conceptual understanding, developing strong number sense, and mastering an efficient set of generalizable strategies. Student readiness for each strategy is ensured at the Prepare phase. Each strategy is then introduced and reinforced before being used to practice the associated facts. This happens through direct instruction as well as through games and a set of specially-designed visual representations, all of which support the Piagetian developmental approach noted above.

Once students have mastered these core strategies, they are able to extend that knowledge. The figure below shows the extension of the three commonly-used addition strategies from basic facts through greater whole numbers, fractions, and decimals.

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<th>First Extension</th>
<th>Further Extensions</th>
<th>Fraction Extension</th>
<th>Decimal Extensions</th>
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<td>Count on 16 + 1</td>
<td>Count on 26 + 21</td>
<td>Count on 3/8 + 1/8</td>
<td>Count on 3.6 + 2.1</td>
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<td>26 + 25</td>
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<td>39 + 4</td>
<td>Bridge to ten 198 + 25</td>
<td>Bridge to ten 5 4/5 + 2 3/5</td>
<td>Bridge to ten 1.98 + 0.06</td>
</tr>
</tbody>
</table>
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Further information about these resources can be found here: [origoeducation.com/fact-strategies](http://origoeducation.com/fact-strategies)
Digital Resources for your Math Toolbox!

Connects
Connecting K-5 math instruction to at home learning

This new digital resource provides an opportunity for parents and caregivers to connect directly with school, allowing for a seamless transition from mathematics classroom instruction to follow-up home support.

CueThink
Bring math problem-solving to life

A new digital tool for documenting and recording problem-solving. Math standards are taught as students apply mathematician George Pólya’s 4 phases of Understand, Plan, Solve, and Review.

Animated Big Books
Share the love of reading in the classroom and at home

Now you can share the love of reading in the classroom and at home with Animated Big Books. These new digital big books are designed to teach math skills conceptually, and in a logical, learner-friendly sequence that develops deep understanding and success.

Further information about these resources can be found here: origoeducation.com/math-toolbox
Focus on what students can do rather than fixating on what they cannot.

Emilia Frias, who has taught English-learners and students with disabilities in special education and general education classrooms, has long understood the struggles her students face.

A former English-language learner who was also identified with learning disabilities as a child, the Magnolia, Calif., school system special education teacher did not learn to read until 6th grade—and her difficulty with reading often carried over to math class, where word problems left her frustrated and puzzled.

Now that she’s on the other side of the equation, Frias uses carefully constructed lessons to meet the disparate needs of her 3rd and 4th grade students with moderate to severe learning disabilities. She is always looking for the individual strengths that will carry them further, and she doesn’t shy away from making words central to her lessons.

During a recent live-video session, Frias used trays filled with home-baked cookies to deliver lessons on multiplication for some, addition and subtraction for others, and counting for those who are still working on one-to-one correspondence—the early math skill of counting each object in a set.

Language Counts

“I had questions for each of those levels: ‘How many were in tray 1?’ ‘How many were in tray 2?’ ‘How many were altogether?’” Frias explained. “Then I had questions like, ‘Which one had more; which one had less?’ And these are questions that I’m typing out for parents to be asking their kids.”

Just like their peers, her students need to know how to use math in life, and that includes mastering math words and phrases, Frias said.

“I want to give them all the vocabulary and terminology, and I would do the same thing with my English-learners,” Frias added. “If we don’t, they’re missing out on a lot of opportunity that their peers have exposure to.”

Cathery Yeh, an assistant professor of teacher education at Chapman University in Orange, Calif., works alongside Frias and other teachers in the Magnolia schools, helping them develop lesson plans and strategies for teaching math to English-learners and students with disabilities.

To reach all their students, math instructors at all levels of K-12 education must shed the belief they only teach math, Yeh said.

“Math teachers—we often see ourselves as content-area teachers. Like our job is to be knowledgeable about math and not necessarily responsible for promoting language development,” Yeh said. “But we have to support learning math through language and learning language through math.”

Labels Can Limit

Part of the challenge in supporting learning lies in being cautious about the overly broad labels attached to students who receive special education or English-learner services. The labels often fail to focus on the strengths or particular needs of students, experts say.

“These kids show up, they have labels” given to them by schools, said Judit Moschkovich, a professor in mathematics education at the University of California, Santa Cruz. “Then we make all kinds of assumptions.”

U.S.-born English-learners could excel or struggle with math. Immigrant students sometimes come to U.S. schools with more math knowledge than their U.S. peers. Some refugee students have missed years of formal schooling.

But however much educators need to pay attention to such differences, they should drop the misconception that English-learner students need to be proficient in the language to learn math, Moschkovich said.

“It takes a long time to learn a second language, and we can’t wait,” she said. “Even as they’re learning English, they are able to learn mathematics and even communicate mathematically.”

Unwarranted assumptions are also made about students with disabilities. Brad Witzel, an education professor and special education program coordinator at Winthrop University in South Carolina, said educators who teach math should define expectations for students based on their skills, not their labels.

“We don’t fully understand the cognitive power of children with disabilities. We’re so stuck on deficit skills we end up focusing on what they can’t remember rather than what the concept to be learned is.”

BRAD WITZEL
EDUCATION PROFESSOR AND SPECIAL EDUCATION PROGRAM COORDINATOR, WINTHROP UNIVERSITY, SOUTH CAROLINA

Math teachers—we often see ourselves as content-area teachers. Like our job is to be knowledgeable about math and not necessarily responsible for promoting language development.”

CATHERY YEH
ASSISTANT PROFESSOR OF TEACHER EDUCATION, CHAPMAN UNIVERSITY, ORANGE, CALIF.
and estimation that parents can replicate with items they can find lying around the house.

With the help of Yeh, Brennan, who teaches in the Magnolia schools, began to shift her thinking about a decade ago from what her students could not do to how math could help sharpen the focus on what strengths they have.

“Society has to change our notions around who can and cannot do math,” Yeh explained. “The goal isn’t for our children to memorize procedures, but to develop ways of knowing and thinking mathematically that can help support them in problem solving and reasoning for life.”

While visiting Brennan’s class when school was still in session, Yeh watched her teach a lesson to her students, who have mild to moderate learning disabilities, on evenly dividing a group of items like pretzels or toys. Educators call this a “fair share” lesson, and it introduced her nonverbal students to the mathematical concepts of division and fractions.

The everyday activity of sharing familiar objects put those concepts within reach for students with IEPs that mandate their math instruction focus on counting, Yeh said. Students can often do more, but to make that happen, educators must be sure the learning connects to their daily lives.

With her strengths perspective, Brennan has even discovered a bright side to the school closures that have forced her and her students into distance learning. As she works with parents at home, she finds many begin to really understand what their children are capable of.

“They could be good at pattern recognition or really understand the principles of the lesson even if they haven’t memorized math facts yet,” the teacher said.

Frias, Brennan’s colleague, learned long ago what she was capable of, and sometimes that understanding is her most valuable lesson to students. In her first special education teaching job, Frias taught in a juvenile-justice facility, where many of her students had learning disabilities. When she explained to them that she also has visual- and auditory-processing disorders, many of them dismissed her claims.

Frias had her mother dig through boxes with her school papers to find a copy of an old IEP. She brought it to class as proof and to deliver a message to her students with disabilities.

“Yes, it is harder for us,” Frias said, “but it doesn’t mean we can’t do it.”

Digital ‘Dora the Explorer’ Helps Young Children Learn Math, Study Finds

By Alyson Klein

Students in the U.S. trail children in other countries when it comes to science, technology, engineering, and math (aka STEM), at least according to international benchmark tests like the Programme for International Student Assessment.

Is a partial solution to that problem letting Dora the Explorer or other popular virtual characters like her teach kids math?

A recent study from the Children’s Digital Media Center at Georgetown University suggests that the answer might be yes.

Researchers, led by Sandra Calvert, the Center’s director, found that kids ages 3-6 who had a strong parasocial (meaning one-sided) relationship with a virtual character (in this case, Dora from the popular cable series) could master math concepts faster with their help.

That’s because “children form relationships” with characters like Dora. “They become social partners for children, if they have these close para-social relationships with characters they learn better,” Calvert said in an interview. And with the advancements in technology, educators may soon be able to harness that relationship. “What’s changed now is that the characters can respond to kids in ways that they couldn’t before.”

The researchers tested more than 200 children ages 3 to 6 on a basic—but important—math technique: the ability to figure out that adding one to a particular number gets you to the next number. All of the children studied hadn’t mastered that skill before the experiment began. Some of those kids came in with a “relationship” with Dora, perhaps from watching the TV show.

The researchers examined how well students learned when a Digital Dora—controlled by an adult who was hidden from view—taught the children the math concept as part of a virtual game. They also examined whether those skills translated to the non-digital world, where students had to demonstrate their learning using physical objects. And they delved into whether students were able to talk about math at a higher level if they got corrective feedback from the character.

The upshot: Dora proved to be a great math tutor, especially for kids who already had a strong connection with her. The kids who had the strongest “relationship” with Dora and talked to her the most about math had faster and better math responses during the virtual game than those who didn’t. The youngsters were also able to demonstrate what they had learned in the virtual game with physical objects if they learned from the character, as opposed to learning from a disembodied voice. And children who received feedback from
the character also performed better.

Of course, having an actual person talking to each individual student is not easily scalable. But developments in artificial intelligence might be able to create an interactive teaching character that would not require an actual person behind the scenes.

That won’t be easy, Calvert acknowledged. “It would be really expensive to make this work,” she said. That’s partly because voice-assisted technology has a tough time understanding small children. “Kids voices have notoriously been difficult to pick up,” she said.

Still, Calvert sees possibilities in the findings. After all, as AI teaching techniques get more sophisticated, kids could be learning math (or social studies or science) from almost any character that they have a strong parasocial relationship with. Parents (or teachers) could choose to have Daniel Tiger teach reading or let Peppa Pig help enforce science concepts.

Dora, Calvert said, “could be swapped out for any character. Whoever it is that your child loves, you could put them into these kinds of settings and get [kids] ready for 21st century learning.”

And it’s possible, Calvert said, that this could even work for older children. (Think of Marvel Comics Captain America as a great civics teacher).

That’s not to say that Cap or Dora or any digital character will ever replace a teacher, Calvert cautioned. Rather, she emphasized that “this could be a tool in their toolkit” to help personalize instruction for students.

OPINION

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Math Instruction in the Age of the Coronavirus

By Bobson Wong and Larisa Bukalov

What does math instruction look like in the age of the coronavirus?

Core Beliefs About Math Instruction

Our teaching has changed in many ways as we’ve moved from in-person to remote instruction. However, our core beliefs about math instruction, pedagogy, and students remain unchanged. In this section, we describe four of these central beliefs and some of the steps we’ve taken to modify our instruction while maintaining them.

1. Students need to feel safe before they can learn.

If students feel threatened, their brains release adrenaline, which inhibits cognitive functions and any other activity that is viewed as unnecessary. Creating a well-organized classroom and a supportive relationship with students sets the foundation for successful learning and helps communicate high expectations. Such an environment encourages students to take chances and reduces their math anxiety, the feelings of fear and tension when doing math.

We find that creating a safe atmosphere is even more important now. Many students live in busy, stressful environments. Some take care of younger siblings or older relatives or share a small home with others. Tensions can be exacerbated when students and teachers are forced to stay at home all day. To maintain a stable environment, we establish clear routines and procedures in our online assignments and meetings so that students know what we expect from them. These routines not only benefit students but also benefit us by helping us manage our schedules.

We also work to maintain the sense of trust with students that we have worked to build throughout the school year. Research indicates that establishing an emotional connection supports learning since it frees up the brain for higher-order thinking. Even simple acts like checking in with individual students periodically can show that we care about them and counter students’ feelings of alienation toward school. Building trust is an important part of culturally responsive teaching, the use of students’ prior experiences to expand their learning capacity. Maintaining connections also prevents us from feeling isolated and maintains our spirits.

2. Math should make sense to students.

As we plan our lessons, we also make sure that the math we teach makes sense to students. Despite the limitations of remote instruction, we resist the temptation to reduce math to “tricks” and shortcuts. Such misguided attempts to save time or energy can quickly backfire if students see the work as pointless and refuse to do it. Although we can’t do the cooperative activities that help students develop conceptual understanding, we incorporate smaller sets of questions that students can work through independently.

3. All students need access to rigorous math.

Students should solve challenging problems that deepen their thinking, not simply complete mindless calculations. Short self-guided discov-
ery activities enable students to actively create knowledge. Recognizing our students’ needs and hidden biases in our own thinking can also make our teaching more relevant and culturally responsive.

4. Teachers don’t have to do everything to succeed.

Under normal circumstances, our classes usually consist of a daily in-class lesson, accompanied by a combination of assignments that include homework, tests, quizzes, and projects. Our students work in class under our supervision and outside of class with friends, with family, or by themselves.

In times like these, though, everyone’s routines—both ours and our students’—have been seriously disrupted. As a result, we try to be flexible and mindful of students’ limited time as well as our own. When we plan lessons, we make sure that students can complete it in a reasonable amount of time. We don’t assume that students will be able to spend the same amount of time at home that they do in school, so we adjust our expectations and our assignments accordingly.

Most importantly, we remind ourselves that we can’t do everything. The strategies we describe in these articles are not a checklist of everything that teachers must do to be effective. Instead, we see them as a collection from which we can pick to improve our instruction. Nowadays, we find that limiting our expectations for ourselves and others helps us maintain our sanity!

Designing Online Math Assignments

Without in-person meetings, our online assignments are the only interaction that we have with many students. As a result, we have to make these assignments as meaningful and manageable as possible. Here are some of the strategies that we use to do so.

Creating Unit Plans

As we do with our regular teaching, we organize our instruction by creating unit plans, documents that map out the major learning goals and the order of lessons for a unit. Unit plans don’t have to be long, complex documents. They can be as simple as a pacing calendar.

Since our year-end goals have changed, we’ve changed our unit plans. In many cases, we’ve limited both the scope and content of our lessons. We omit topics that would be too challenging for us to explain remotely. Instead, we present new material only if it extends previously learned concepts. We occasionally give assignments like projects or other activities, which provide a welcome change to our routine. However, we limit these assignments to small activities that students could complete largely on their own with little or no research.

Posting Online Assignments

Just as we have routines and procedures in our physical classrooms, we also establish them in our online assignments. Routines and procedures make classrooms more predictable, which helps students focus on learning.

To keep our online assignments more organized, we first simplify our work by giving no more than one assignment per day for each course or subject. Under normal circumstances, we would give both classwork and homework, but giving two or more online assignments per day can overwhelm students who are unaccustomed to managing all of their time at home. To make our work more manageable, we post one assignment every day. If we give larger assignments, we split it into smaller parts.

We post all of our assignments on a class website. When we post an assignment, we include the following:

- **Title and date**: Numbering assignments helps us refer to them more easily. To communicate more clearly when assignments are due, we put due dates and the aim directly in the assignment’s title, such as “HW #16: How do we solve quadratic equations by completing the square? (Due Wed. 4/15/20).” Grouping assignments by category or subject helps students find them more easily.

- **Online resources**: We include links to videos or websites that students can use to understand the lesson. These resources enable students to learn at their own pace and allow us to provide differentiated resources for English-language learners. However, we find that students often need additional help, so we also run online meetings.

- **Directions**: Instead of using pedagogical jargon (“In this assignment, students will be able to use the equation of a linear model to solve problems in the context of bivariate measurement data.”), we prefer clear, simple language (“Today, we’ll use linear equations in two variables to model real-world problems.”). This enables students—and anyone else that may be helping them—to understand our directions.

- **Template for student responses**: To help students organize their thoughts and to make grading easier, we create templates containing the questions that we want answered and appropriate space for student work. Websites like DeltaMath that automatically grade student responses can simplify grading. We also give students multiple ways to submit their work. For example, if we want students to complete a worksheet, we allow them to type directly on the worksheet or upload written work on a printed copy.

We try to be flexible with assignment deadlines. Although we clearly (and repeatedly) state deadlines, we accept late submissions without penalty. If students consistently miss work, we
We summarize our lesson with:

- **Mini-lesson:** We then present a brief lesson—usually no more than five minutes—that summarizes important or especially tricky concepts. We ask students to turn off their audio and video (some apps allow the host to do this with one click). Doing so minimizes distractions from background noise, improves our sound quality by reducing the bandwidth, and protects student privacy if we record the lesson and upload it online. Students who want to ask questions can type comments in the online chat area or unmute themselves temporarily. To help students see what we’re discussing, we share our screen with students so that we can display problems, relevant animations, or other helpful visuals.

- **Feedback:** We devote most of our online meeting to giving students time to ask questions and develop skills. Students who feel comfortable may discuss a solution or ask a question by sharing their screen, turning their video on, or typing in the online chat area. If we put problems on slides, we allow students to speak while we write on our slides for them. If students don’t have any immediate questions, we allow them to work independently until they need help.

- **Summary:** We summarize our lesson with a question that enables us to gauge our students’ understanding of the lesson. For example, we ask students to type their answer into an online form (such as a Google Form) so we can instantly collect and analyze student answers. We then review the question with students and remind them again of upcoming assignments, such as homework.

Although we consider these meetings important, we also recognize that many students aren’t able to participate. Some of our students have told us that they have limited internet access, share a crowded and noisy home, care for younger siblings, or are grieving the loss of a loved one. To accommodate these, we find that compassion goes a long way. We then present a brief lesson, discuss upcoming assignments, or other helpful visuals. As we proceed, we share our screen with students so that we can display problems, relevant animations, or other helpful visuals.

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Although we consider these meetings important, we also recognize that many students aren’t able to participate. Some of our students have told us that they have limited internet access, share a crowded and noisy home, care for younger siblings, or are grieving the loss of a loved one. To accommodate this, we encourage students to turn on their audio and video but only if they feel comfortable doing so. We also use this time to make announcements, such as reminders of upcoming assignments. If appropriate, we also share some personal updates about our own lives, which helps remind students that we’re human!
STEM graduates. In fact, we don’t need to start with integration at all. The problem lies in an avoidance and anxiety toward mathematics that begins as early as 5 years old.

Educators can successfully integrate math with other core subjects, but I wonder why we are focused almost entirely on integration. Integrating mathematics isn’t an easy thing to do well. Often times it is math that is put in the passenger seat to lightly serve another subject, project, or task.

So what is quality math instruction? Quality math instruction is real-world, collaborative, and involves productive struggle, debate, and conversation. Integrating unproductive math practices into other content areas is counterproductive for any STEM program or school. Instead, healthy math classrooms have time when the math is integrated and also times when it is not. We know that developing deeper mathematical conceptual understanding takes time, perseverance, and a learning community free of anxiety. Research tells us that these are the things that our youngest students need most as they begin to develop their math identities. Integrated content cannot be the sole focus of STEM programs if it comes at the expense of addressing math anxiety.

Students need to learn critical thinking skills. They need time to apply their learning in an integrated and authentic way. They need time to develop their success skills. But those things alone do not make a successful STEM program.

If our programs and schools do not produce more students capable of graduating with a STEM major, then are they successful? My concern isn’t just that many students continue to avoid math—I already know that. My concern comes from the realization that STEM education, the very thing that should be combatting this problem, seems to be focused on everything but the actual barrier.

Gina Picha is an elementary instructional coach for a public school district near Austin, Texas.
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