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Column

Should we stop making kids memorize times tables?

Stanford professor criticizes New York state's interpretation of Common Core math standards

Education by the Numbers

Column by **JILL BARSHAY** **February 9, 2015**

Stanford University's Jo Boaler says teachers and parents should stop using math flash cards, stop drilling kids in addition and multiplication and especially stop forcing students to do calculations quickly under time pressure. Good-bye Mad Minute Mondays, where teachers hand out quiz sheets with 50 problems to be completed in less than a minute. But wait — doesn't everyone have to learn times tables? No, says Boaler.

Although her position is unorthodox, Boaler, an education professor

and researcher, has spent a career trying to prove why it is the best way for kids to learn.

"Drilling without understanding is harmful," Boaler said in an interview. "I'm not saying that math facts aren't important. I'm saying that math facts are best learned when we understand them and use them in different situations."

In a new working paper, "Fluency Without Fear: Research Evidence on the Best Ways to Learn Math Facts," updated and published online on January 28, 2015, Boaler argues that many common math teaching tools — flash cards, math sprints and repetitive worksheets — are not only unhelpful, but also "damaging." And she singles out the new Common Core math curriculum in New York state, saying it misinterprets numerical "fluency" to mean rote memorization and speed.

U.S. News & World Report

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Jo Boaler, Stanford University

Boaler's argument has several parts. She explains that the key to success in math is having something called "number sense," and number sense is developed through "rich" mathematical problems. Too much emphasis on rote memorization, she says, inhibits students' abilities to think about numbers creatively, to build them up and break them down. She cites her own 2009 study, which found that low achieving students tended to memorize methods and were unable to interact with numbers flexibly. And she is currently working on a study with

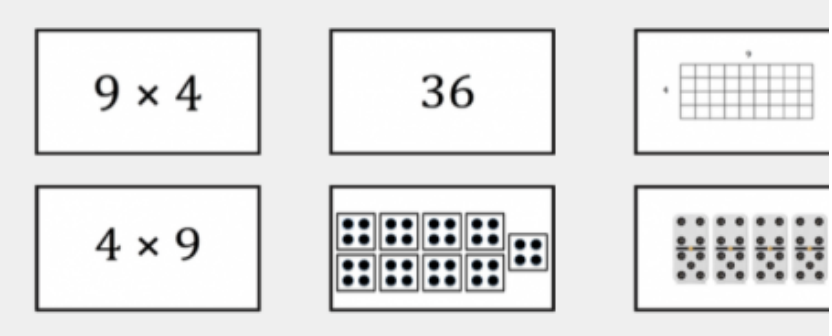
the Organization for Economic Cooperation and Development (OECD) in which she is finding that the lowest performing students in the world are the ones who think math is about memorization.

Also, Boaler argues that memorization of boring math facts, such as times tables, turns students off from math. Often, they're high achieving students who have the kind of creative minds that would otherwise excel at it.

The most compelling research evidence that Boaler presents is about how time pressure provokes math anxiety in many students. More than a third of students, according to one study cited by Boaler, experience extreme stress around timed tests. A 2013 University of Chicago study found that that the working memory portion of the brain becomes blocked in stressed students and they cannot access the math facts that they know. Over time, the anxiety builds and their confidence erodes.

Boaler admits not everyone is harmed by timed math quizzes, but doesn't see anyone benefitting from them either. "Some students are fine with them," she said. "But when we combine those who are stressed with those who are turned away from math because of them, we have a large section of the U.S. population that goes across all achievement levels."

I asked Boaler if rote memorization might be a beneficial supplement to a rich mathematics curriculum that emphasizes creative problem solving. Just the way that the fast repetition of scales is useful for a Juilliard musician, for example, or vocabulary



Jo Boaler says these types of math cards, depicted in "Fluency witho Fear," help students practice math without blind memorization.

drilling is useful for a foreign language student. But Boaler says that "mathematical ideas" are different, and stands by her position that times tables are unnecessary. "I never memorized my times tables as a child because I grew up in a progressive era in the U.K.," Boaler said. "It's never held me back."

The human brain is forgetful by nature, she argues, and what she wants is students to develop the number sense to calculate 7 x 8 quickly even when their brains can't recall the math fact instantly. (For example, you might remember that 7 x 7 is 49 and then add 7 to that to arrive at 56). Students who learned primarily through rote might freeze during an inevitable moment of forgetfulness, and be unable to think through the problem and come to an answer efficiently.

I telephoned Kumon, which produces the kind of repetitive worksheets that Boaler abhors, to see if there's another side of the story. Mary Mokris, a senior advisor there, defended the importance of learning times tables so thoroughly that it becomes automatic.

"You need that automaticity to build a foundation and go to the next step," she said, adding that measuring speed was also important because it helps the instructor gauge how well the student has mastered the material.

As for research, Mokris pointed to brain science studies that have shown that repetition helps build synapses in the brain. "Until you have the repetition, you can't build the paths," she said.

And indeed, when you dig deeper into Boaler's paper, she is a big fan of practice and repetition. But Boaler distinguishes this from blind memorization. In the appendix, she attaches an unusual set of math

cards that she says helps promote mathematical insight and number sense. Rather than straightforward sums to solve, the cards depict numbers in different ways.

Of course, any sort of repetition will lead to memorization. You wouldn't really be calculating 7 x 8 by picturing blocks every single time you need to make a quick calculation. The more you repeat it, the more natural it becomes to have the answer pop into your head. But Boaler is convinced that the student who memorizes through usage, not drilling, will be better off.

Ultimately we need more research to show what kind of practice works best.

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