When Math Makes Sense (To Everyone)

By DAVID BORNSTEIN

In response to Tuesday’s column about Jump Math, an approach to math education that is showing impressive results in schools in Canada and England, a great many readers wrote in to share stories of how they or their children have struggled with math (or, in some cases, were almost traumatized by it). “I failed math as a school-aged boy,” wrote Rob Blake, from New York. “I avoided math like one of the 10 plagues.”

Josh Fraser
Mary Jane Moreau, a teacher at The Mabin School in Toronto, worked with grade 5 children on their JUMP workbooks. Many asked how they could get more information about Jump. Parents or educators can get teaching guides and lesson plans free from Jump Math’s Web site (registration is required). Workbooks are available for sale; proceeds support the organization, which is a nonprofit.

John Mighton, a mathematician who is the founder of Jump, has also written a book called “The End of Ignorance,” which details the program’s philosophy and explains how it contrasts with current teaching approaches.

For the many adults who expressed interest in upgrading their own math skills, Mighton suggested working through Jump’s eighth grade teachers’ guides and lessons. “If people understand the material in that book (fractions, ratios, percents, simple algebra, integers, etc.) they will have an easier time moving on to more advanced math,” he explained. “If grade eight is too advanced start with a lower book.” Jump is also developing an entry-level math program for community colleges that will be ready next year.

Readers were divided on the question of whether all children are, in fact, capable of excelling math. “I have never found yet a child who does not understand math,” wrote Ambabelle from Paris. “I have found many who do not understand the math taught by the school.” Harry Hoopes from West Chester, Pa., saw it differently: “Some (many) children are just not intelligent enough to learn. Stop talking about possibilities and pie in the sky.” And Al A. from Buffalo, NY, preferred to preserve the tracking approach that has long been in use. “I would suggest that you break the classes up into those gifted in math … and let them move ahead of those that you choose to teach the ‘new math way,’” he wrote.

The question is: To what degree are our beliefs about children’s abilities determined by the results of our current education system? Or, as Mighton puts it, “Our belief in hierarchies is producing the hierarchies.” We may not know what we are capable of achieving. Mighton is a case in point. As a youth, he was fascinated by math, but he wasn’t a natural. He almost failed his first calculus course. But he trained himself to break down complicated tasks and practice them until things that initially confused him became second nature. He went on to do a Ph.D in mathematics.

This path is more common than we imagine. Research on experts – whether in chess, cello or computer programming – indicates that natural ability is less a predictor of success than effort and deliberate practice. A big part of what we call “giftedness” is “task commitment” – and that can be encouraged.

Courtesy of Elisha Bonnis Elisha Bonnis
One bottleneck is that many teachers are uncomfortable with math. They have trouble breaking it down or conveying enthusiasm for the subject. This was the case with Elisha Bonnis, who teaches Jump in the fourth and fifth grades at General Wolfe Elementary School, in Vancouver. Bonnis grew up in a poor family. Neither of her parents finished high school, and because of illnesses as a child, she missed long stretches of school. She fell behind and lost all confidence in her ability to do math. By the time she reached high school, she was failing badly, and acting out. “I really believed I was stupid,” she told me. “I ended up being expelled from two different high schools.”

Bonnis later decided to go to college. Her dream was to become a school teacher. She had to take a math prerequisite – which she struggled through, hating every minute. As a teacher, she harbored a “dark secret;” math terrified her. She felt that she was doing her students a disservice by teaching it.

The turning point was the day she attended a training session given by Mighton, which made her think she could conquer math. She got the Jump materials and began using them in her classes — but secretly, because she was supposed to use a standard textbook. “I found I could understand the lessons,” she said. “For me, that was pretty big.” And she began to see changes in her students.

One of them was a boy named Abdirahman Elni, 11, who is now in the sixth grade. I asked Elni about his math experiences. “Before I did Jump Math,” he told me, “I was in Math Makes Sense [the name of his previous textbook] and I had frustrating times and got lower marks.” He got C’s; now he gets A’s. What changed? “The Math Makes Sense gives you ways where you don’t understand how you’re doing it,” he explained. “In Jump Math they actually explain it to you properly.”

In June, Bonnis will complete a master’s degree in mathematics education. When she started using Jump, other teachers questioned her decision; now almost every first to sixth grade teacher in her school uses the curriculum. Jump doesn’t market its materials with fanfare. Where it has spread, the primary driver has been word of mouth by teachers. A number of readers requested information about the inner workings of the program. Elisabeth, from New York inquired: “How does it work with large classes? What happens with the kids who don’t need the micro-steps? Do they get bored or frustrated with the small steps?” And Ratna, from Houston, TX, was concerned that “the Jump program would bore the heck out of the ‘math naturals.’” Indyreader from Indianapolis assumed that it would require “a lot more individual attention — a lot more teacher-hours and resources … than most schools are able to afford.”
The key to Jump is a balance between step-by-step guidance and encouraging inquiry and problem solving. The main challenge Mighton has grappled with is: How can a teacher implement Jump in a classroom where students are working at multiple levels simultaneously? His approach is to provide teachers an array of bonus questions that step up the level of difficulty. The bonus work needs to be challenging enough to motivate students, but it can’t introduce too much new information – otherwise the teacher will end up spending more time helping the quicker students learn new material than helping the weaker students master the current lesson. Take for example a fifth-grade lesson on perimeter. The first step may be to have students calculate the perimeter of a simple L-shape made up of three squares, each side measuring one unit. Some kids will spend more time getting comfortable with counting the perimeter correctly. For kids who go faster, more challenges will be layered on. They might be questions like: What happens if you add a square to that shape? Can you do it without changing the perimeter? Can you create a shape where adding a square will reduce the perimeter? Or the teacher may introduce other shapes with multiple sides missing or give examples with lengths in the thousands.

The teacher needs to stay on top of the students, continuously assessing whether they get the current step, and ready with the next level of bonus work when they do. Children who need more time to practice are afforded that time, while faster students go deeper by playing with small variations on the idea. “We don’t rush over things that the kids need time to absorb,” Mighton says. “But they are not passive observers. They are problem solving all the time; it’s just in a manageable way.”

Here’s another example for a fifth grade class: The teacher puts five blocks on one table. On another, she’ll place two blocks next to a bag with a hidden number of blocks inside. The children are told that both tables have the same number of blocks. The first question is: How many are hidden in the bag (5 = 2 + bag)? After the kids get used to that, the teacher will make it more complex: say, make one block visible, and have two bags, each with the same number (5 = 1 + bag + bag). “Once they’ve got that you can really start raising the level of difficulty,” explains Mighton.

The teacher can introduce more blocks and bags, or represent them on the blackboard with circles in a box. To solve problems, the weaker kids can draw circles in the boxes, counting as they go. For stronger kids, the teacher can introduce numbers instead of pictures and eventually replace the boxes with letters, solving for x. The weak kids can take part because they see physically what’s happening; at the same time, the teacher can make the questions harder and harder. “After you replace the box with a letter, young kids think they’re brilliant – being able to do algebra,” says Mighton. “It’s a great confidence builder.”

Students are making discoveries, but they are not left to sink or swim. The teacher is orchestrating a set of challenges to make those discoveries possible. Carefully circumscribed situations that allow students to stretch themselves is what the psychologist Lev Vygotsky called the “zone of proximal development.” Mighton, who also has an M.A. in philosophy, says Jump’s approach follows in the Socratic tradition. “Socrates was a master of introducing concepts incrementally through a series of questions,” he says. “To do Socratic inquiry the questions have to be very well designed. People don’t recognize in math how difficult it is to design those questions so that the whole class can answer them.”

A number of readers were concerned that Jump would hold back quicker students. But in Lambeth, England, faster kids also accelerated their progress. Tracy Solomon, who led the randomized controlled study of Jump in Ontario, also observed that “kids across the entire spectrum” showed gains. She argued that educators should take note of these results. “When you use a program that veers from the established philosophy and you get significant effects,” she said, “I think it at least suggests that we need to have a broader and more inclusive view of what’s effective for mathematics instruction.” [1]

Teachers say that when all of their students take part in lessons, the class develops a math-learning culture and the kids plow through material. Children feed off the energy of other children. But when hierarchies exist, certain students feel unsuccessful. They may feel anxious: they may tune out or try to disrupt the class – and this can dampen the enthusiasm of the whole group. “There really is only one advantage to putting kids in a group when you’re trying to teach them,” Mighton adds. “It’s easier to get them excited. And when we create hierarchies we throw away the one advantage we have.”

A Chicago parent (32.) wrote: “On a personal level, I cringe when I hear once again that all students are equally capable.” But that’s not the claim here. “What the data suggest is that we can raise the levels of achievement for virtually everyone, so that those differences won’t matter much,” says Mighton. “And children will at least have a choice about whether they want to pursue math or subjects involving math.”

In life, many factors determine success. Whether a scientist will make a profound discovery is not just due to sheer quickness of mind. “Passion, diligence, a willingness to ask unconventional questions, a sense of beauty, and luck — these are all equally important,” adds Mighton. “The point is that if children are all investigators, they are all participating in a beautiful game. As long as they are all contributing, what does it matter if some people are contributing more than others?”

[1]: Studies of the effectiveness of math programs are typically poorly controlled. The U.S. Department of Education and the Johns Hopkins University School of Education provide rankings of math programs based on the available evidence of their effectiveness.