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EXCLUSIVE INTERVIEW

EDUCATION MINISTER **DHARMENDRA PRADHAN**

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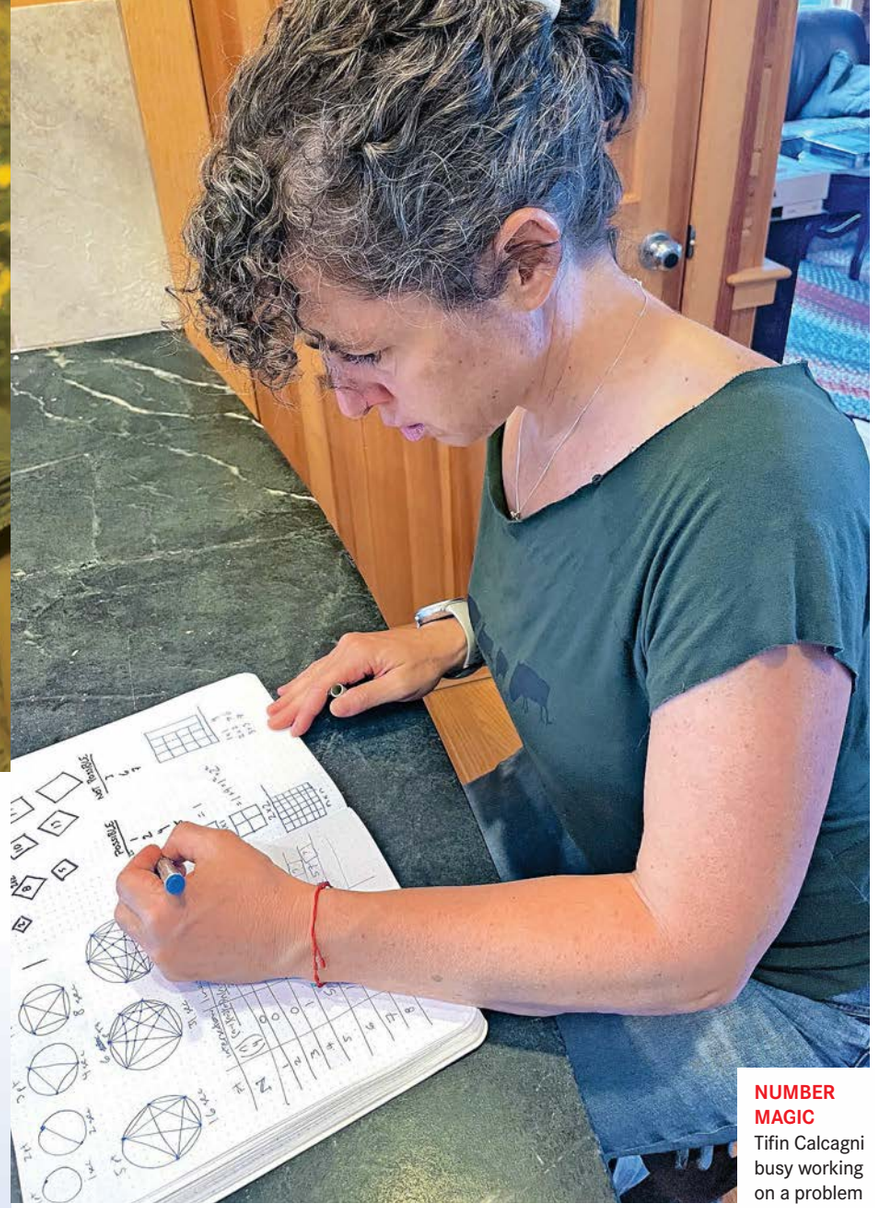


NUMBER MAGIC
Tifin Calcagni busy working on a problem

Math comes full circle

A math teacher and a unique programme are changing children's perception about the dreaded subject

BY MILAN SIME MARTINIC

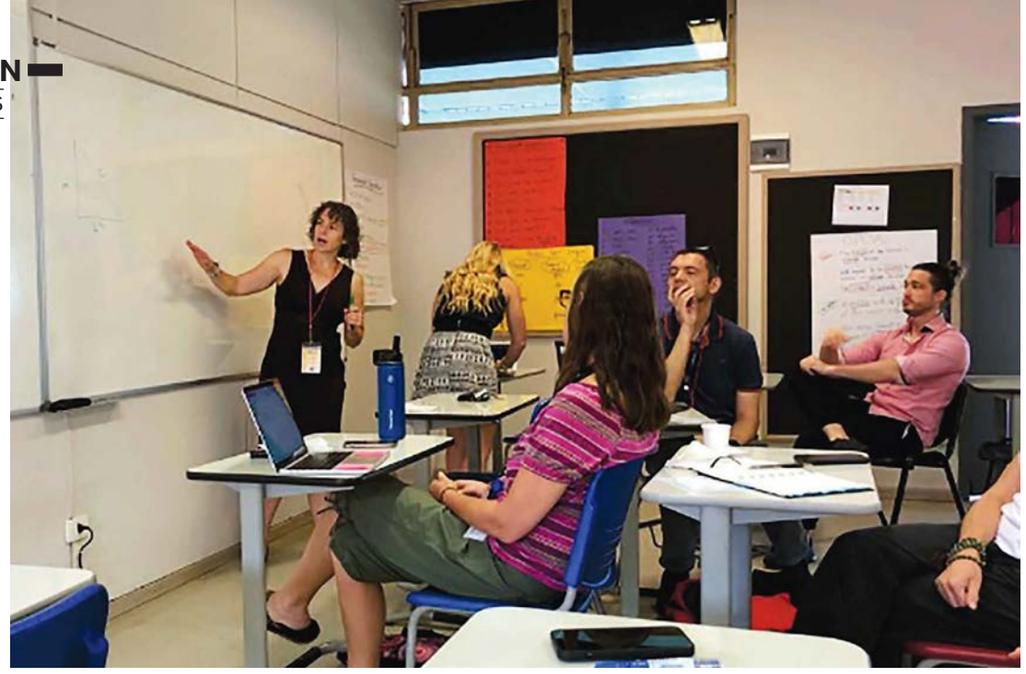
-I do not understand fractions.
How old are you?
-Nine.
And, six months ago?
-Eight-and-a-half.
And just like that, the nine-year-old understood fractions.

TIFIN CALCAGNI IS filling the downtime in the middle of a meeting drawing circles and connecting dots. She is in another world, a world of numbers, working on a problem that kept her awake the night before. But her world transcends the numbers and patterns in front of her and opens into a larger enrichment of the human experience.

She is a brilliant mathematical mind but is convinced that mathematics is within everyone's reach, and she is out to make mathematics something that people enjoy. She is a teacher by training but hear her talk mathematics and it is almost as hearing poetry for the first time, well, the mathematical version of it.

"Math is a beautiful thing, and it gives us a framework for understanding and appreciating beauty in other realms," says Calcagni. "It sounds ambitious, but my hope is that it will make kids' lives more pleasurable and fulfilling, whatever they end up doing."

And, she is doing this as a teacher and as the driving force behind the Global Math Circle programme, a pioneering project reaching children from India to Brazil to America and open to children the world over. The Global Math



TEACHING TECHNIQUE
Calcagni training math circle leaders

Circle (www.theglobalmathcircle.org) can be distilled to its maxim, 'Tell me and I forget. Ask me and I discover.' It is a different approach to teaching math—not by directing or showing but by asking questions that lead to discovery. There is no standard grading system, and the teachers follow the maxim quite strictly.

"Curiosity is always a finer spur than rivalry," explains Calcagni. "We do not diminish the students' discoveries by reciting the famous names of those who had gone this way before. Mathematics is our universal language, but each of us learns to make our own."

Mathematics is to be understood and discovered, says Calcagni, who has taught in Brazil, Kazakhstan, Tunisia, Switzerland, Canada and the US. "Discovering patterns and finding where they lead," she says. This results in discovering mathematics instead of memorising it. "When kids discover and explore mathematics, not only is it more fun, but it leads to a deeper level of understanding and an ability to think mathematically," she says. "Kids who learn this way are more willing to try to solve problems that they don't initially understand."

According to Global Math Circle, what most schools teach is not what mathematicians do. "Mathematicians do not repeat the same technique 20 times; they play with problems, they discuss them, they explore side-branches, they make mistakes," it says.

For the next year, Calcagni will be coaching and supporting circle leaders, training them, developing resources for them, and supporting schools and after-school programmes that want to implement math circles.

The Global Math Circle has a different approach to teaching math—not by directing or showing but by asking questions that lead to discovery.

Life has come full circle for Calcagni, who began her math circle journey when she was trying to improve her teaching tools. She contacted Robert and Ellen Kaplan of Harvard, after reading their book on the math circle approach that made math a playful, joyful search.

When the Kaplans took the Global Math Circle programme online, Calcagni was by their side teaching math circles. "But the demand for circles was more than the three of us could provide, so Bob started bringing on PhD candidates to do outreach with us," says Calcagni. "These amazing mathematicians had very creative plans for classes."

The pandemic created some difficulties, and they lost some leaders. But after Google invited Kaplan to do a recorded demo for children, Calcagni says that some Google employees joined the Global Math Circle board and upgraded its systems.

Everyone is a math person, is Calcagni's message and mission. "Math can be learned, just like anything else," she says. "It's not for the gifted or privileged or those with a specific type of brain."

And, she proves that with an example. Exploring prime numbers can stump even practiced mathematicians, but Calcagni's pedagogic approach provides a glimpse into the value of the math circle approach she heads.

Let's start with rectangles, she says, and explains how taking a different number of square blocks can make rectangles by aligning one square next to the other in a straight line. Then she points out that a set of four blocks can be stacked to make a rectangle, say two blocks on top and two at the bottom, making a four-block square. Then she asks, which numbers of blocks can make more than one rectangle?

Math Circle participants, she says, will, with a bit of exploration, notice that every even number over two can do this. They will quickly discover that any multiple of any number will be able to make more than one rectangle. The prime numbers make only one rectangle. It is these patterns that hold the answer on how to find the prime numbers.

"Kids learn that if they do not think the same way as the teacher, if they cannot quickly and efficiently apply an algorithm in the correct situation, that they are not a 'math person,'" says Calcagni. This is not at all true, she adds. It is learning to think creatively about patterns that is important in understanding mathematics, she explains. Algorithms are secondary. But mathematics in schools has been reduced to this, and it is all kids are taught is important. This may be true for a computer, but not for a person.

"We can, however, unlearn that memorising algorithms is important, and kids can easily start exploring again, when given the chance," says Calcagni. "And if presented with the correct level of problem in a non-competitive, accepting environment, they often do."

The Global Math Circle, a non-profit organisation, trains teachers on the art of guiding shared discovery and has students in India working alongside students in other parts of the world. It accepts children of all ages and offers scholarships based solely on financial need. It is the math circle's vision and Calcagni's goal to see a world where math is everyone's favourite subject, to see schools where kids are excited to work together to discover the mysteries and secrets of the universe.

As Calcagni says, "Together, we can reveal the secrets of something that, individually, we thought was unknowable."