

## By The Numbers

The 'newer math' may well revolutionize the way kids learn -- and help them enjoy it

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Arvind Gupta, a leading mathematical researcher, points to his three daughters as examples of what is wrong with math education in British Columbia.

Although his girls do well in the subject, they have no interest in pursuing it as a career.

And that, unfortunately, is typical, says Gupta, chief executive officer and scientific director at a Simon Fraser University centre of excellence known as MITACS -- Mathematics of Information Technology and Complex Systems.

"Surprising as it is to me, kids are turning away in even larger numbers than before from mathematical sciences," Gupta said in an interview. "It's a huge worry for us because the world is demanding more and more quantitative skills in individuals."

The problem for B.C. and many other jurisdictions isn't only a dearth of mathematicians. It's also a lack of numeracy, or basic number sense, says Carole Saundry, a private consultant and math coordinator in the Richmond school district.

The example she uses is that of a customer who gives a store clerk \$2.02 to pay for an item costing \$1.37. The clerk returns the two pennies, saying, "You've given me too much."

Such awkwardness with numbers is not uncommon. Saundry says it's the result of teaching and learning math in a style that has not changed significantly in a century and has left students without the understanding they need in the modern world.

But now, changes are happening in B.C. that will bring a significant shift in the way math is taught from kindergarten to Grade 12. They were introduced in September in elementary schools, and will roll into the remaining grades by 2012.

The changes will be both broad and profound, and some could even be termed startling. For example: primary students will no longer use calculators, nor be



CREDIT: Ian Lindsay, Vancouver Sun  
Math education specialist Carole Saundry works with Grade 1 and kindergarten students in a classroom at Tait Elementary in Richmond. She also advises parents about math.

taught to tell time; there will be less reliance on calculators throughout the elementary years; instead of learning division by rote memorization of a process (Can this divisor "go into" that dividend with no remainder?) it will be based on the idea of breaking a number into groups, like sharing out candies.

The three math streams in high school -- principles, applications and essentials -- that have caused headaches for senior high school students will be replaced by new streams.

In essence, students will be taught the "why" of math equations rather than just the "how."

"Revolutionize may not be too strong a word," Keven Elder, president of the B.C. School Superintendents' Association, said of the new approach.

"It really has begun to revolutionize the way that mathematics is taught and learned, with a real focus on engagement and meaning-making."

These reforms are more than just curriculum revisions intended to address flagging test scores. In fact, math scores are not a key concern because B.C. students generally do well in national and international tests, ranking among the top 10 worldwide and nationally, falling behind only Alberta and, occasionally, Quebec.

What they address is a troubling lack of engagement in mathematics at a time when such knowledge is becoming increasingly important, Elder explained. That lack of engagement leads students to think that complicated math formulas need only to be memorized to graduate, but may then be happily forgotten.

It's an attitude that produces many adults who must rely on calculators to add up double-digit figures or estimate percentages.

B.C.'s concern about the way it teaches math is shared by most other provinces and this new approach is echoed far beyond its borders. The changes were originally developed by the Western and Northern Canadian Protocol for Collaboration in Education, which has been bringing four provinces and three territories together for 15 years to develop common curriculum and learning outcomes in math, language arts and international languages.

This "newer math" has also been adopted by the Atlantic provinces, which suggests it is becoming the first national curriculum in a country where education is a provincial responsibility, Saundry noted.

Led by Alberta, the revisions were based on international research into mathematical learning, with special attention paid to exactly when students are developmentally best prepared to learn specific math concepts. Special attention was also given to two countries that excel in math instruction -- Japan and Singapore -- although their approaches could not be transplanted in whole.

Peter Liljedahl, an SFU assistant education professor, said research into the teaching of math is extensive and it's driving curriculum revisions around the world. "If you look at curriculum revisions that happened years and year ago, they were not as informed by research as they are nowadays."

One of the most significant changes in the new math is a thinning-out of a curriculum that has long been criticized for being "stuffed" to the point that teachers can't deal adequately with all of the material. They have long complained that the breadth of the curriculum forced them to rush through some topics and ignore others.

It was, many said, a mile wide and an inch deep.

By reducing the number of topics, teachers will be able to concentrate on key concepts and ensure that students learn them well, Liljedahl said.

Decisions about which lessons should be dropped or delayed were guided by research into when students are ready to learn particular concepts.

For example, primary classes will no longer include lessons about probability or telling time because research suggests children aren't ready for such tasks until they are nine or 10 years old.

At the same time, kindergarten and Grade 1 teachers will begin introducing basic algebraic concepts.

"They've done a really, really good job of figuring out which topics should fit at what years in order to maximize students' developmental readiness," Liljedahl said.

Another change will see the three math streams in Grades 10, 11 and 12 -- essentials, applications and principles -- replaced by streams (or courses) that more closely match students' post-secondary ambitions.

Currently, students opt for the more specialized Principles of Math stream to ensure they can enter university, instead of the Applications of Math stream, which was deemed more relevant for the majority of students.

The new streams, developed in consultation with post-secondary institutions, are expected to more closely match students' aspirations, although Bruce McAskill, a math consultant who conducted the study that led to the changes, said the institutions have not yet given their approval.

"The early response has been positive, but universities are likely to wait until they see the resources," added McAskill.

Cynthia Nicol, associate education professor at the University of B.C., said universities would prefer that students arrive with a strong foundation in mathematics -- a good sense of fractions, the ability to multiply without calculators. "Those are the skills that would do a person well (when) entering into university."

A third change has to do with relevance and the ability of students to learn discrete skills to apply in the real world.

"A numerate student is someone who's able to use whatever skills they have available to solve whatever problem is at hand," Liljedahl said.

"We're trying to make more numerate students.

"That classically is something that we haven't seen in our students in the past and you know industry complains about this all the time. (The) industry says, 'They don't know how to do anything.' But that's not true.

"We actually got them through Math 12 and Math 12 is a really hard topic . . . but the students sort of compartmentalize that as 'mathematics for the classroom' and learn it in that context and never take anything with them outside."

Gupta, who is leading the way in recruiting, training and placing a new generation of mathematicians, is not involved with the K-12 curriculum changes but is anxious to see anything that will foster interest in math. "We as a country

have to recognize that this is a huge issue," he said. "We're just not doing as good a job as we could in getting kids excited and engaged."

MITACS is exploring ways of making math more meaningful, by embedding it in video games or introducing math lessons in amusement parks, such as the physics classes that regularly explore topics like momentum, kinetic energy and acceleration at the Pacific National Exhibition.

"I'm personally not as concerned that they all study math as just they don't shy away from math in whatever field they study," Gupta said. "It would be great to see more kids studying math, but I think we just need to raise the appreciation of math overall in society."

The bottom line is that math shouldn't be considered a subject for brainy students only. All students need to understand the basic concepts from the start or they will be forever handicapped.

"If kids miss something early on, they're in trouble," he said. "But I've seen very few kids who don't fundamentally understand mathematics. It's logical, it's systematic. It's much easier than writing an English essay."

The response from teachers who have been using the new math has been positive, Elder said. "They're reporting considerably more engagement, considerably more interest. It's making a real difference in attitudes."

A negative attitude can be a major impediment to learning math. Irene Lanzinger, the B.C. Teachers' Federation president and a former math and science teacher, said many people -- students and adults -- are averse to math.

"With science, most people can find something they like in it, whereas if someone has a block to math, it's very difficult to get over that," she said. "If kids find math difficult . . . at some point, they decide they can't do it and once they've made that decision, it's an uphill battle."

Lanzinger said the emphasis in the new curriculum on building solid skills in early grades is positive, and anecdotal reports suggest teachers are enthusiastic about the new approach. But she noted the introduction of these far-reaching changes needs the full backing of the Education Ministry to be successful and "I'm skeptical about whether that will happen."

In fact, others said British Columbia -- like several other provinces -- stopped supporting curriculum changes a number of years ago, opting instead to leave that to school districts.

That has created work for private consultants like Saundry, who has been touring the province to help teachers and parents understand the new curriculum.

"I'm pretty much run off my feet," she said this week. "The demand is enormous."

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A NEW WAY TO DO LONG DIVISION

Carole Saundry is a math coordinator for the Richmond school district who also

works as a private consultant explaining the new math to parents. She offers the following example of how the new math will change long division.

"The traditional algorithm focuses not on sharing but on numbers 'going into' other numbers. A strange thing even to visualize, no? The new way of modelling and recording long division is based on the idea of sharing, and depends on a child knowing only the multiplication facts of 1, 2, 5, and 10 -- yes, the easy ones!!

"Imagine you have 359 candies on a table, and you have 16 children who want to share them. How many would you give to each child to start? 1, 2, 5 or 10 each? Most would say 10 each, just to make everyone happy. So if we give away 10 each, that's 16 times 10 or 160 candies that are gone.

"To figure out how many are left, we need to subtract 160 from 359 (or find the difference between them). We can do that by adjusting the top number, because if you were subtracting from 360 that would be so much easier. ... To do that you have to add one to 359, find the difference ( $360 - 160 = 200$ ) and then take away that one you added before. You now have 199 candies left, and the kids are still hungry, so you continue, giving away sets of candies to each child until there are too few to divide up. What one does with the 'remainder' in this case is a great conversation."

Read more at Saundry's blog: <http://mindfull.wordpress.com>

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