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In L.A., Singapore math has added value

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Here's a little math problem:

In 2005, just 45% of the fifth-graders at Ramona Elementary School in Hollywood scored at grade level on a standardized state test. In 2006, that figure rose to 76%. What was the difference?

If you answered 31 percentage points, you are correct. You could also express it as a 69% increase.

But there is another, more intriguing answer: The difference between the two years may have been Singapore math.

At the start of the 2005-06 school year, Ramona began using textbooks developed for use in Singapore, a Southeast Asian city-state whose pupils consistently rank No. 1 in international math comparisons. Ramona's math scores soared.

"It's wonderful," said Principal Susan Arcaris. "Seven out of 10 of the students in our school are proficient or better in math, and that's pretty startling when you consider that this is an inner-city, Title 1 school."

Ramona easily qualifies for federal Title 1 funds, which are intended to alleviate the effects of poverty. Nine of every 10 students at the school are eligible for free or reduced-price lunches. For the most part, these are the children of immigrants, the majority from Central America, some from Armenia. Nearly six in 10 students speak English as a second language.

Yet here they are, outpacing their counterparts in more affluent schools and succeeding in a math curriculum designed for students who are the very stereotype of Asian dominance in math and science.

How did that happen?

It's a question with potentially big implications, because California recently became the first state to include the Singapore series on its list of state-approved elementary math texts. Public schools aren't required to use the books – there are a number of other, more conventional texts on the state list – but the state will subsidize the purchase if they do. And being on the list puts an important imprimatur on the books, because California is by far the largest, most influential textbook buyer in the country.

The decision to approve the books could place California ahead of the national curve. The National Mathematics Advisory Panel, appointed by President Bush, will issue a report Thursday that is expected to endorse K-8 math reforms that, in many ways, mirror the Singapore curriculum.

The report could also signal a cease-fire in the state's math wars, which raged between traditionalists and reformers

throughout the 1990s and shook up math teachers nationwide. Fundamentalists called for a return to basics; reformers demanded a curriculum that would emphasize conceptual understanding.

Mathematicians on both sides of the divide say the Singapore curriculum teaches both. By hammering on the basics, it instills a deep understanding of key concepts, they say.

Kids – at least the kids at Ramona – seem to love it.

Ramona, which received a grant to introduce the Singapore curriculum, is one of a sprinkling of schools around the country to do so.

Not all teachers like it, and not all use it. The Singapore books aren't easy for teachers to use without training, and some veterans are more comfortable with the curriculum they have always followed. But you can tell when you walk into a classroom using Singapore math.

“On your mark ... get set ... THINK!”

First-grade teacher Arpie Liparian stands in front of her class with a stopwatch. The only sound is of pencils scratching paper as the students race through the daily “sprint,” a 60-second drill that is a key part of the Singapore system. The problems at this age are simple: $2+3$, $3+4$, $8+2$. The idea, once commonplace in math classrooms, is to practice them until they become second nature.

Critics call this “drill and kill,” but Ramona's math coach, Robin Ramos, calls it “drill and thrill.” The children act as though it's a game. Not everyone finishes all 30 problems in 60 seconds, and only one girl gets all the answers right, but the students are bubbling with excitement. And Liparian praises every effort.

“Give yourselves a hand, boys and girls,” she says when all the drills have been corrected. “You did a wonderful job.”

Reinforcing patterns

What isn't obvious to a casual observer is that this drill is carefully thought out to reinforce patterns of mathematical thinking that carry through the curriculum. “These are ‘procedures with connections,’” Ramos said, arranged to convey sometimes subtle points. This thoughtfulness – some say brilliance – is the true hallmark of the Singapore books, advocates say.

After 10 years of studying the Singapore curriculum, Yoram Sagher, a math professor at the University of Illinois at Chicago, said he still has “very pleasant surprises and realizations” while reading the books. Sagher, who helped train Ramos and the other teachers at Ramona, said he is constantly amazed by “the gentle, clever ways that the mathematics is brought to the intuition of the students.”

The books, with the no-nonsense title “Primary Mathematics,” are published for the U.S. market by a small company in Oregon, Marshall Cavendish International. They are slim volumes, weighing a fraction of a conventional American text. They have a spare, stripped-down look, and a given page contains no material that isn't directly related to the lesson at hand.

Standing in an empty classroom one recent morning, Ramos flipped through two sets of texts: the Singapore books and those of a conventional math series published by Harcourt. She began with the first lesson in the first chapter of first grade.

In Harcourt Math, there was a picture of eight trees. There were two circles in the sky. The instructions told the students: “There are 2 birds in all.” There were no birds on the page.

The instructions directed the students to draw little yellow disks in the circles to represent the birds.

Ramos gave a look of exasperation. Without a visual representation of birds, she said, the math is confusing and

overly abstract for a 5- or 6-year-old. “The math doesn’t jump out of the page here,” she said.

The Singapore first-grade text, by contrast, could hardly have been clearer. It began with a blank rectangle and the number and word for “zero.” Below that was a rectangle with a single robot in it, and the number and word for “one.” Then a rectangle with two dolls, and the number and word for “two,” and so on.

“This page is very pictorial, but it refers to something very concrete,” Ramos said. “Something they can understand.”

Next to the pictures were dots. Beginning with the number six (represented by six pineapples), the dots were arranged in two rows, so that six was presented as one row of five dots and a second row with one dot.

Day one, first grade: the beginnings of set theory.

“This concept, right at the beginning, is the foundation for very important mathematics,” Ramos said. As it progresses, the Singapore math builds on this, often in ways that are invisible to the children.

Word problems in the early grades are always solved the same way: Draw a picture representing the problem and its solution. Then express it with numbers, and finally write it in words. “The whole concept,” Ramos says, “is concrete to pictorial to abstract.”

Another hallmark of the Singapore books is that there is little repetition. Students are expected to attain mastery of a concept and move on. Each concept builds upon the next. As a result, the books cover far fewer topics in a given year than standard American texts.

Skilled at math

Singapore is a prosperous, multicultural, multilingual nation of 4.5 million people whose fourth- and eighth-grade students have never scored lower than No. 1 in a widely accepted comparison of global math skills, the Trends in International Mathematics and Science Study. U.S. students score in the middle of the pack.

When the U.S. Department of Education commissioned a study in 2005 to find out why, it concluded, in part: “Singapore’s textbooks build deep understanding of mathematical concepts through multi-step problems and concrete illustrations that demonstrate how abstract mathematical concepts are used to solve problems from different perspectives.”

By contrast, the study said, “traditional U.S. textbooks rarely get beyond definitions and formulas, developing only students’ mechanical ability to apply mathematical concepts.”

Many eminent mathematicians agree. In fact, it is difficult to find a mathematician who likes the standard American texts or dislikes Singapore’s.

“The Singapore texts don’t make a huge deal about the concepts, but they present them in the correct and economical form,” said Roger Howe, a professor of mathematics at Yale University. “It provides the basis for a very orderly and systematic conceptual understanding of arithmetic and mathematics.”

The Singapore curriculum is not strikingly different from that used in many countries known for their math prowess, especially in Asia and Eastern Europe, math educators say. According to James Milgram, a math professor at Stanford who is one of the authors of California’s math standards, the Singapore system has its roots in math curricula developed in the former Soviet Union, whose success in math and science sent shivers through American policymakers during the Cold War.

The Soviets, Milgram said, brought together mathematicians and developmental psychologists to devise the best way to teach math to children. They did “exactly what I would have done had I been given free rein to design the math standards in California. They cut the thing down to its core.”

The Soviet curriculum was adopted by China in the mid-1950s, he said, and later made its way to Singapore, where it was rewritten and refined. The Singapore texts could easily be adapted for use in the United States because children there are taught in English.

“American textbooks are handicapped by many things,” said Hung-Hsi Wu, who has taught math at UC Berkeley for 42 years, “the most important of which is to regard mathematics as a collection of factoids to be memorized.”

One might think that school districts would be lining up to get their hands on the Singapore texts, but no one expects many to take the plunge this fall.

“Maybe in seven or eight years, but not yet,” said Wu. For now, he said he’d be surprised if the Singapore books claim 10% of the market.

In part, that may reflect the inherent conservatism of the education establishment, especially in large districts such as Los Angeles Unified, whose math curriculum specialists said in December, a month after the Singapore texts were adopted by the state, that they hadn’t even heard of them – or of the successful experiment taking place in one of their own schools.

But there is also an understandable reluctance to rush into a new curriculum before teachers are trained to use it. Complicating that, experts said, is that most American elementary school teachers – reflecting a generally math-phobic society – lack a strong foundation in the subject to begin with.

The Singapore curriculum “requires a considerable amount of math background on the part of the teachers who are teaching it,” said Milgram, “and in the elementary grades, most of our teachers aren’t capable of teaching it... . It isn’t that they can’t learn it; it’s just that they’ve never seen it.”

Training is key

Adding to the difficulty is that the Singapore texts are not as teacher-friendly as most American texts. “They don’t come with teachers editions, or two-page fold-outs with comments, or step-by-step instructions about how to give the lessons,” said Yale’s Howe. “Most U.S. elementary teachers don’t currently have that kind of understanding, so successful use of the Singapore books would require substantial professional development.”

Although some U.S. schools have had spectacular results using Singapore texts, others have fared less well. A study found that success in Montgomery County, Md., schools using the Singapore books was directly related to teacher training. At schools where teachers weren’t trained as well, student achievement declined.

Sagher, the Illinois professor, said that he would love to see Ramona Elementary become a training ground for L.A. Unified teachers and that Singapore math could radiate out from its Hollywood beachhead. Districtwide, only 43% of fifth-graders last year scored at grade level or above in math, 33 points below Ramona students. “If LAUSD is smart enough to do it, it will be a revolution,” he said.

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