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Expecting the Best Yields Results in Massachusetts

By **KENNETH CHANG**

BRAINTREE, Mass. — Conventional wisdom and popular perception hold that American students are falling further and further behind in science and math achievement. The statistics from this state tell a different story.

If Massachusetts were a country, its eighth graders would rank second in the world in science, behind only Singapore, according to [Timss](#) — the Trends in International Mathematics and Science Study, which surveys knowledge and skills of fourth and eighth graders around the world. (The most recent version, in 2011, tested more than 600,000 students in 63 nations.)

Massachusetts eighth graders also did well in mathematics, coming in sixth, behind Korea, Singapore, Taiwan, Hong Kong and Japan. The United States as a whole came in 10th in science and 9th in math, [with scores that were above the international average](#).

Of course, Timss is only one test, and achievement tests are incomplete indicators of educational prowess. But behind Massachusetts' raw numbers are two decades of sustained efforts to lift science and mathematics education. Educators and officials chose a course and held to it, even when the early results were deeply disappointing.

While Massachusetts has a richer and better-educated population than most states, it is not uniformly wealthy. The gains reflected improvement across the state, including poorer districts.

“I think we are a proof point of what’s possible,” said Mitchell D. Chester, the state education commissioner.

On a sunny day in May, fifth graders at Donald E. Ross Elementary School here were gathered at an outdoor gazebo, learning about fulcrums by using a ruler set up like a seesaw and balancing weights at both ends.

At South Middle School, seventh graders in a science class worked in small groups to brainstorm how a box of items — a plastic jar, beaker, water, and a mix of sand, soil, clay and pebbles — could

help answer a question posed by the teacher: How do sediments carried in water get deposited? They devised small experiments and wrote down their observations, and at the end of class each group presented its findings.

None of the topics were novel, but they were consistent in their hands-on approach, inviting students to explore and explain. “Much more hands-on than what we ever used to do,” said Dianne D. Rees, the district’s science director. “Hands-on as much as possible.”

Braintree, a town of about 35,000 south of Boston, is neither an inner-city area nor a wealthy suburb. “We’re sort of, we used to say, a blue-collar area,” said William Kendall, the director of mathematics and technology for the Braintree schools.

When Dr. Kendall arrived in 1973 as a math teacher, the standard approach was talking at the front of the classroom and writing on the blackboard.

Some children learned well from lectures. Others did not. “And it was O.K. those people don’t get it, because only we, the math elite, get it,” Dr. Kendall said.

Back then, one could graduate from high school without ever taking algebra. “Then came ed reform,” Dr. Kendall said, “and now everybody had to learn math.”

Ambitious Goals

“Ed reform” was the Massachusetts Education Reform Act of 1993, passed by a Democratic Legislature and signed by a Republican governor, William F. Weld.

The three core components were more money (mostly to the urban schools), ambitious academic standards and a high-stakes test that students had to pass before collecting their high school diplomas. All students were expected to learn algebra before high school.

“It was a combination of carrots and sticks,” said David P. Driscoll, deputy education commissioner at the time.

Also noteworthy was what the reforms did not include. Parents were not offered vouchers for private schools. The state did not close poorly performing schools, eliminate tenure for teachers or add merit pay. The reforms did allow for some [charter schools](#), but not many.

Then the state, by and large, stayed the course.

The new achievement test, the Massachusetts Comprehensive Assessment System (MCAS for short), was given to 10th graders for the first time in 1998. (The graduation requirement of obtaining an acceptable score on the 10th-grade MCAS did not take effect until 2003.)

The troubled urban schools performed terribly.

In the small city of Chelsea, which borders Boston, almost 90 percent of the students come from low-income families and most did not speak English as their first language. On the first MCAS, two-thirds of Chelsea 10th graders failed math. The science scores were nearly as dismal.

Two years later, scores in the urban districts showed only glacial improvement. A report from the University of Massachusetts at Boston concluded that the [reforms were not delivering on the promises](#).

Critics worried that when the use of MCAS as a graduation requirement kicked in, thousands of students would be deprived of their diplomas and would drop out in despair. Dr. Driscoll, who was elevated to education commissioner in 1998, kept the MCAS.

“People were expecting it to go away,” Robert D. Gaudet, the lead UMass researcher, recalled in a recent interview. “He held to his guns.”

Officials did make adjustments. Students who fail the MCAS can retake it several times until they pass, and can still graduate if they otherwise demonstrate they have learned the material.

Test scores have risen markedly. Last year, 54 percent of Chelsea 10th graders were proficient or advanced on the math MCAS.

On tests administered by the federal Education Department, Massachusetts, which had been above average, rose to No. 1 among the 50 states in math.

Building Blocks

Two decades after Massachusetts passed its education reform, there is still much disagreement over what were the crucial components to its success.

Some think it was the added money; others note that successful countries operate schools at much lower costs.

Some think high-stakes testing imposed accountability on administrators, teachers and students;

others say that it merely added stress and that the proliferation of tests takes away too much time from learning.

Some think the standards gave clarity on what was expected of teachers and students; others say there is little correlation between well-written standards and student performance.

Officials like Dr. Driscoll say all three components were essential.

Dr. Rees, the Braintree schools' science director, said the standards helped make sure that teachers across the state covered the same subjects, laying the groundwork for subsequent grades.

“There’s a logic to that, a progression,” she said. “You start learning about solids in kindergarten. In first grade, you learn about solids and liquids, and then in second grade, you start to learn about solids and liquids and gases.”

The MCAS has helped Braintree figure out what works and what doesn't. Middle school students were struggling with chemistry questions on the eighth-grade MCAS. The district changed the order of instruction, covering concrete science concepts in sixth grade and moving some chemistry topics to seventh. “And it worked,” Dr. Rees said. “They’re doing better on their chemistry.”

Still, Massachusetts officials admit they have more to do.

While scores have improved across the board, the gap between the highest achievers and the lowest — notably blacks, Hispanics and special education students — has persisted.

Seeing Results

At East Middle School, the elixir is Kristen Walsh, who teaches math to sixth, seventh and eighth graders with so-called special needs, a potpourri of learning disabilities that include [dyslexia](#) and [autism](#). On this day she was introducing a lesson on variables and linear equations with a problem involving gym memberships.

She explained the usual math concepts of beginning algebra — the slope of a line indicating the rate of change, the y intercept where the line intersects the y axis. Where she lingered was less the math concepts but the words used in the word problem, repeatedly checking that the students understood that the “start-up fee” of one health club was the same thing as the membership fee at another.

In essence, she was teaching how to interpret a math problem as much as how to solve it.

Dr. Kendall says teachers now laugh when he tells them that it was once possible to graduate from Braintree High School without ever taking algebra. “You can’t get out of eighth grade without knowing Algebra I now,” he said. “We’re teaching it to everybody, and everybody is having success.”

The first new math standards in Massachusetts, in the 1990s, echoed the “constructivist” pedagogy then in vogue. Students would construct their knowledge through trial and error, resulting in a deeper understanding.

But many parents rebelled, complaining that their children never mastered basic skills. The state officials in charge of the next revision wanted a back-to-basics curriculum. But Dr. Kendall and others argued that that old approach had already failed.

The “math wars” erupted at the turn of the millennium, culminating in a sort of détente — constructivism was purged, but the new Massachusetts standards did not prescribe a new approach. They stated what students were to learn, but not how teachers were to teach. “What came out of it ended up being a good document, because it contained no pedagogy,” Dr. Kendall said.

That allowed teachers like Ms. Walsh to devise and improve.

Take the multiplication table. The traditional approach was to memorize it in order. A strict constructivist would have children figure it out by playing with sticks and other so-called manipulatives.

Braintree combines those approaches, with the teachers guiding the learning in a particular order.

“Now research shows when you’re teaching multiplication facts, you should start with the 2s, go to the 10s, go to the 5s, do the 4, the 8, don’t hit 0, because the idea of multiplying 0 by 0 is complicated, until they’ve got a foundation in multiplication,” Dr. Kendall said. “Do 0 and 1 in about the middle, and save 7 and 3 until the end, because those are the really hard ones.”

He added, “We’re helping them construct their own knowledge in a way that is successful.”

Abby Federico, one of Ms. Walsh’s special-needs students, said her mother told her the middle school math curriculum was much more advanced than when she was in school. “She was like, ‘I learned this stuff in high school,’ ” Abby said.

Dr. Kendall said that special needs students in Braintree used to routinely fail the math MCAS.

Now those in Ms. Walsh’s class often get “proficient.”

“It’s pretty easy in my opinion, because Ms. Walsh usually teaches us a lot of methods to use in math to make it seem easier,” Abby said, adding that she might even choose a career that requires math skills.

“Math is pretty nice,” she said.



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