

# Math Education at Risk

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Two decades ago, the United States awoke to headlines declaring that it was "A Nation at Risk." In dramatic language, the National Commission on Excellence in Education warned of a "rising tide of mediocrity" that, had it been "imposed by a foreign power," might well have been interpreted as "an act of war." Shortly thereafter, dismal results from a major international assessment of mathematics education confirmed the commission's judgment. Analysts at that time described U.S. mathematics education as the product of an "underachieving curriculum."

Alarmed by these unfavorable assessments, mathematicians and mathematics educators launched an energetic and coordinated campaign to move mathematics education out from underachievement. Their strategy: national standards for school mathematics--an unprecedented venture for the United States--coordinated with textbooks, tests, and teacher training. Science shortly followed suit in this campaign for standards, as did other subjects.

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By 1990, the president and the state governors formally adopted six national goals for education, including this one: "By the year 2000, United States students will be the first in the world in mathematics and science achievement." Subsequently, states established standards in core academic subjects and introduced tests aligned with these standards to measure the performance of students, teachers, and schools.

Yet today, the nation remains very much at risk in this area. Although newsmaking perils appear more immediate (viruses, terrorists, deficits, unemployment), underachievement in education remains the most certain long-term national threat. Despite brave rhetoric and countless projects, we have not vanquished educational mediocrity, especially not in mathematics and science. Judging by recent policy proposals, we have not even grasped the true character of the problem.

## **Solid effort, poor results**

The nation may deserve an A for effort, or at least a B+. All states but one have established content standards in mathematics, and most have done so in science. The number of states requiring more than two years of high-school mathematics and science has doubled. Many more high-school students, including students in all racial and ethnic groups, now take advanced mathematics and science courses. International comparisons show that U.S. students receive at least as much instruction in mathematics and science as students in other nations, and spend about as much time on homework.

Notwithstanding these notable efforts, data from national and international assessments show that, with one exception, none of the nation's grand objectives for mathematics and science education has been met or even approached.

- Student performance has stagnated. The average mathematics performance of 17-year-olds on the National Assessment of Educational Progress (NAEP) is essentially the same now as it was in 1973. During the 1970s, performance declined slightly, then rose during the 1980s, but has remained essentially constant since then. Science performance on the NAEP during the past three decades has generally mirrored that of mathematics: decline followed by recovery and then stagnation.
- Mathematics performance remains substandard. In 2000, only one in six 12th-grade students achieved the NAEP "proficient" level, and only 1 in 50 performed at the "advanced" level. That same year, 34 percent of all students enrolled in postsecondary mathematics department were in remedial courses, up from 28 percent in 1980.
- The gap between low- and high-performing students is immense. In mathematics, the difference between the highest and lowest NAEP quartiles for 17-year-olds is approximately the same as the difference between the average scores for 17- and 9-year-olds--roughly equivalent to eight years of schooling.
- Racial and ethnic gaps are persistent and large. In 2000, one in three Asian/Pacific Islanders in the 12th grade and one in five white 12th graders scored at the NAEP's proficient level, but less than 1 in 25 Hispanic and black 12th graders scored at that level. Modest gains during the 1970s and 1980s narrowed longstanding gaps among racial and ethnic groups, but there is no evidence of any further narrowing since 1990. In fact, there is some evidence that the gap between whites and blacks in mathematics has widened.

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- Students in poverty perform poorly. Twelfth-grade students who are eligible for the national school lunch program perform on the NAEP at about the same level as 8th-grade students who are not in the school lunch program. Throughout school, low-income students are twice as likely as their higher-income peers to score below the "basic" level of achievement in mathematics.
- U.S. students remain uncompetitive internationally. Repeated assessments reveal little improvement in the U.S. ranking among nations and a widening of the cross-national achievement gap as students progress through school. Even the most advanced U.S. students perform poorly compared with similarly advanced students in other countries. Confirming evidence could be seen (at least when the economy was flourishing) in urgent business support for the H1-B visa program, which allows U.S. companies to hire skilled foreign workers when no U.S. citizens have proper qualifications.

One important exception to this recital of failure is gender equity. After decades of underrepresentation, girls are now as likely as boys to take advanced mathematics classes and more likely to take biology and chemistry. They remain, however, less likely to take physics. More important, the differences in performance between boys and girls on most high-school mathematics and science examinations are no longer statistically significant.

College attendance has increased dramatically during the past 20 years, even among low-performing students. At the same time, failure rates on high-school exit tests that are aligned with new state standards have shocked parents and led to political revolts. More telling, the gap between high- and low-performing students within each grade remains particularly wide, posing a major challenge for new mandatory programs designed to hold all students accountable to the same set of high standards.

### **Dearth of remedies**

Many diagnoses but few remedies have emerged. International comparisons suggest that mathematics and science curricula in the United States are excessively repetitive and slight important topics. Instruction in U.S. classrooms focuses on developing routine skills (often to prepare students for high-stakes tests) and offers few opportunities for students to engage in high-level mathematical thinking.

In the mid-1990s, a vociferous national argument erupted over how to respond to this new round of dismal tidings (dubbed the "Math Wars" by the media). Advocates of traditional curricula and pedagogy were pitted against people who argued that old methods had failed and that new approaches

were needed for the computer age. This debate in mathematics education paralleled contemporaneous cultural divides over reading, core curricula, and traditional values.

The lack of demonstrable progress in improving educational performance in mathematics and other subjects has led some people to view the problem as inherently unsolvable within a system of public education. This view is often supported by statistics that appear to show little correlation between expenditures and achievement in education from kindergarten through 12th grade. Down this road lies the political quagmire of vouchers and school choice.

Other observers see the lack of progress more as an indicator of flawed strategies--of widespread underestimation of the depth of understanding and intensity of effort required to teach mathematics effectively. A lack of respect for the complexity of the problem encourages quick fixes (smaller classes, higher standards, more tests, higher teacher salaries) that do not yield greater disciplinary understanding or pedagogical skill.

A decade after the first President Bush said that the United States would be "first in the world," Congress enacted the signature legislation of another President Bush, sadly entitled "No Child Left Behind." Faced with overwhelming evidence of failure to meet the 1990 goal, this unprecedented legislation imposes the authority and financial muscle of the federal government across the entire landscape of K-12 education. The law mandates annual testing of students in the 3rd through 8th grades and in 11th grade, with reporting disaggregated by ethnic categories. Schools that do not demonstrate annual improvements in each category at each grade are subject to various sanctions, and students in these "failing" schools will be allowed to move to other schools.

Advocates of federally mandated tests argue that making progress requires measuring progress. Critics see classrooms turning into test-prep centers, where depth and cohesion are abandoned for isolated skills found on standardized tests. Totally absent from the current debate is the 1990s ideal of being "first in the world." Chastened by experience, the nation's new educational aspiration appears much more modest: Just avoid putting children at risk.

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