Math and Science Achievement

The results of the Trends in International Mathematics and Science Study (TIMSS) tests for 2003 were released on 14 December 2004. They contain some important messages about what's happening globally in math and science education—messages that are taken increasingly seriously by the nearly 50 participating nations and, we hope, by the readers of *Science*. The tests, also given in 1995 and 1999, measure mathematics and science achievement at grades 4 and 8 (reflecting an average of 4 or 8 years of schooling, respectively). Because they are closely linked to school mathematics and science curricula in the participating countries, the tests yield data on student achievement that relate to the concepts learned in their own schools.

Comparative national data for mathematics and science in both grades reveal a near-monopoly by Asia in the top-scoring group, including Singapore, Korea, Hong Kong, Taiwan, and Japan. Several European nations cluster below that, and the United States and several other nations are in the next set. There is a considerable spread of scores among nations, with the average scaled scores from eighth-grade mathematics ranging from 605 (Singapore) to 264 (South Africa). Some of the "best performer" nations were those who ranked high on the United Nations Development Programme's Human Development Index (HDI), but students in Hungary, Malaysia, and South Korea, for example, did much better than their country's HDI. Between 1995 and 2003, scores for both fourth- and eighth-graders in both disciplines increased or held constant in most nations in the TIMSS samples, with improvement being especially noteworthy in fourth-grade mathematics scores. For international science, that's good news.

In the United States, mathematics and science education has been a core item in the national debate over education reform at the K–12 level, and active national and local efforts have focused on curriculum improvement. So how did U.S. students do on TIMSS? At grade 4, between 1995 and 2003, U.S. student scores held constant, although their international ranking declined slightly. But the average scores of U.S. eighth-graders made statistically significant improvements between 1995 and 2003 in both mathematics and science. In other good news, as described by the U.S. Subpopulation Performance analysis, eighth-grade African-American and Hispanic students demonstrated improvement in both mathematics and sciences over that 8-year span, and their average science scores narrowed the achievement gap that previously separated their performance from that of whites.

These gains should provide some comfort to U.S. scientists who worry about the health of elementary education. Can we find a cause? Some will surely give credit to the No Child Left Behind (NCLB) legislation, but that can be set aside as political optimism. NCLB was passed only in 2001, too late for much influence on the assessment results. On the other hand, national standards, including the National Council of Teachers of Mathematics (NCTM) Standards (1989), the American Association for the Advancement of Science (AAAS) Benchmarks for Science Literacy (1993), and the National Research Council (NRC) National Science Education Standards (1995), have been around for just about the right length of time. There has been a significant cumulative effect of these national standards on the educational system as they have influenced state standards, textbook selection, and assessments and, less directly, teacher education. So we think that a strong argument can be made for linking these standards to the improvement we see in the TIMSS results.

Education reform takes time, but the results suggest that some progress is beginning to show. TIMSS is always a sobering test for U.S. educators, because the results force a comparison of their system—which insists on the right of 50 states and 15,000 school districts to shape their own mathematics and science programs—with centrally organized systems such as that of Singapore, the world leader. The results represented by TIMSS 2003 would suggest giving accelerated emphasis to strong voluntary national standards. That is a challenging prescription for a nation devoted to local control, and one that is made more difficult by the increasing efforts in a number of school districts to mandate courses that offer religious "alternatives" to scientific theories.

Perhaps the 2003 TIMSS results will, in addition to providing a baseline for comparing international educational systems, persuade U.S. policy-makers to count the costs of leaving everything to local decision-making.

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