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A monthly in-depth look at states and communities and their efforts to reach the National Education Goals
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Topic Highlighted in this Issue:

International Mathematics and Science Achievement

States in this Issue:

INDIANA
MICHIGAN
OREGON

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BENCHMARKING WITH TIMSS GIVES STATES, DISTRICTS BASIS FOR REFORMS

The 27 states and districts that volunteered to be part of the Third International Mathematics and Science Study (TIMSS) in 1999 were “brave,” in the words of several national leaders who spoke at the early April press conference announcing the results. They also now have a richer source of data with which to analyze their standards, curriculum, instructional strategies, and resource distribution. The study assessed eighth-grade students in mathematics and science and gathered data on their curriculum, instruction, and home support. The benchmarking states and districts involved 1,000 schools, 4,000 teachers, and 50,000 students in the math and science testing.

While praising the participating states and districts, U.S. Secretary of Education Ronald Paige noted that the study revealed “we not only have an achievement gap in our country, but also one between us and our neighboring countries.” Thirty-eight countries took part in this second round of TIMSS (the first was in 1995). National results from the 1999 version, also known as TIMSS-Repeat or TIMSS-R, were released in December. The new information compares performance of the states and districts with that of the United States and other nations.

For the most part, results from the 13 participating states hovered near the United States average in math and slightly better in science. The United States performed in the middle of the achievement distribution of the participating countries. Five Asian countries set the top performance in both subjects—Singapore, the Republic of Korea, Chinese Taipei, Hong Kong SAR, and Japan. No state was among the top 10 performers.

Individual districts or consortia of districts from the United States ranked among the best, however, in terms of average achievement. The Naperville School District #203 west of Chicago was first among all of the countries, states, and districts in science achievement and the highest-ranking participant from the

United States in mathematics. Also among the top performers were the First in the World Consortium, which includes 18 districts north of Chicago; the Michigan Invitational Group, a cross-section of different types of school districts in Michigan; and the Academy School District in Colorado Springs, Colo.

The four districts with the largest numbers of low-income and minority students were far below the United States and international averages, although they did better than several large countries. The great disparity of achievement within the United States confirms results from other sources of data, such as the National Assessment of Educational Progress, but the TIMSS-R is the first to illuminate the stark disparities within states. There is a larger difference in performance between Chicago and its suburbs, for example, than between the United States and Singapore.

The message, many experts are emphasizing, is that American students can perform at the highest levels when they have adequate resources and help. While students in high-wealth districts would be expected to perform well, the Michigan Invitational Group is a case in point about the effect of a strong curriculum and quality professional development. The schools in the Invitational Group represent a socio-economic mix, including an inner-city middle school in Detroit, but they were a top-performing consortia on TIMSS-R. The schools all agreed to use National Science Foundation-developed materials; align curriculum, assessment, and professional development; use data for continuous improvement, and communicate their goals and progress with parents and communities.

The nation's urban districts "are not interested in being tested against a different standard," according to Michael Casserly, executive director of the Council of the Great City Schools. "We have a lot of work to do, but so does the nation," he said, in terms of providing sufficient resources for all students. Among the resources identified as important by TIMSS-R are well-qualified teachers, a challenging curriculum, and environments conducive to learning.

The TIMSS-R results ought to be a wake-up call for all states and districts, in the opinion of Robert Schwartz, president of Achieve, Inc., which is providing help to states on developing world-class education standards. Some states are doing better than others, he noted, "but none performed significantly better than the United States as a nation, and the gap between our best states and the rest that took part in TIMSS should be a cause for alarm."

WHAT TIMSS-R RESULTS TELL

TIMSS-R provides policymakers and educators with a great deal of information to study and to use as tools for improvement. The data provide information on instructional practices, teachers' backgrounds and professional development, support at home, resources, and school environments. For example:

- Resources in the home, such as the number of books, are a significant factor within the United States between the highest performing and lowest performing districts/consortia. Home resources, however, are not as important in some high-performing countries. Chinese Taipei, for example, had about the same index of students at the high level of home resources (8 percent) as did Rochester, Chicago, Jersey City, and Miami-Dade County.
- The states/districts in the benchmarking study generally reflect past TIMSS' results as to their strengths and weaknesses in both the math and the science curricula. The

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students did less well in measurement and geometry, better in fractions and number sense, data representation, and algebra. They did less well in physics than in other science content areas. Urban districts provided algebra to eighth graders at a much lower rate than other participating districts. The data also show different patterns within the content on the basis of gender.

- The content taught in the benchmarking states and districts was surprisingly similar in both math and science and generally not very rigorous. The great variation in achievement, experts assumed, probably is due to the depth of the instruction and the way in which the content is taught.
- Top-performing students had an ability to generalize and solve non-routine or contextualized problems while low-performing students were primarily able to use routine procedures with numbers. On the basis of self-reporting from teachers, there was tremendous variation among the benchmarking states/districts on the use of problem solving in instruction. The number of teachers in The First in the World Consortium and the Michigan Invitational Group who reported using problem solving was high (41 to 46 percent), but teachers in Jersey City also reported similarly high levels. In Chicago and Oregon, this strategy occurred in most lessons only 8-9 percent, according to the teachers.
- Teachers in the benchmarking entities had greater assurance about teaching math than the international average (but less than the United States average). They felt less confident about their skills to teach science.
- On average internationally, 71 percent of the students were taught by teachers with majors in math. In the United States, the average was 41 percent, but the figure varied from 16 percent in Jersey City to 73 percent in Naperville and First in the World. The United States had the highest percentage of students in science classes taught by teachers with a general education major.
- Time is an important factor, but more important is the quality of the time. Students in the United States have more instructional time in math and science than students internationally, though teachers in some high-performing entities such as Naperville and Korea reported less instructional time than many other TIMSS participants. Classes in the United States, however, are interrupted much more often, and students take class time to do homework more frequently.

What Next?

Each TIMSS-R benchmarking participant will receive a detailed analysis from the United States' coordinator, the International Study Center of the Lynch School of Education at Boston College. They contracted directly with the Center for data collection activities in their own jurisdiction. TIMSS-R was a joint venture of the Office of Educational Research and Improvement in the U.S. Department of Education, the National Science Foundation, and the National Center for Education Statistics. TIMSS is a collaborative research project of the International Association for the Evaluation of Educational Achievement.

The benchmarking states and districts plan to follow up the reports in various ways. The First in the World consortium, which worked with the North Central Regional Educational Laboratory (NCREL) after receiving results from the 1995 TIMSS, will continue to align its curriculum, instructional practices, and professional development. NCREL developed a guide for using the data from TIMSS. The Miami-Dade County district reported that it plans to redesign its curriculum to eliminate repetition and find better ways to present the math and science curriculum to language-minority students. Illinois will distribute videotapes of instruction in the Naperville district throughout the state, according to a report in *Education Week.*

Plans are now underway for another administration of TIMSS in 2003.

States participating in the TIMSS 1999 benchmarking included Connecticut, Idaho, Illinois, Indiana, Maryland, Massachusetts, Michigan, Missouri, North Carolina, Oregon, Pennsylvania, South Carolina, and Texas. The districts and consortia included Academy School District #20, Colorado Springs, CO; Chicago public schools; Delaware Science Coalition; First in the World Consortium (Illinois); Fremont/Lincoln/Westside Public Schools (Nebraska); Guilford County, NC; Jersey City public schools; Miami-Dade County public schools (FL); Michigan Invitational Group; Montgomery County, MD; Naperville Community Unit School District #203 (Illinois); Project SMART Consortium (Ohio); Rochester City School District, NY; and the Southwest Pennsylvania Math and Science Collaborative.

The states that performed closest to the top-performing countries on both the math and science tests report long-term and comprehensive efforts at improving student achievement in these subjects. These include Indiana, Michigan, and Oregon.

INDIANA

Legislation that required school districts to participate in the National Assessment of Educational Progress and in TIMSS sent a message to districts that the state was intent on making sure the public education system "is on track," according to Cheryl Orr of the Indiana Education Roundtable. Content standards have been in place in Indiana for eight years, with assessments aligned to the standards, but it is important, she explains, for policymakers and educators "to look outside of themselves."

The Education Roundtable, organized by the governor three years ago and coordinated by the Indiana Commission for Higher Education, has created a partnership that works on various facets of school improvement. "We have a triangle of the governor's office, higher education institutions, and the Department of Education that is making sure standards are part of everyone's work," Orr says.

THE NATIONAL EDUCATION GOALS

Goal 1: Ready to Learn

Goal 2: School Completion

Goal 3: Student Achievement and Citizenship

Goal 4: Teacher Education and Professional Development

Goal 5: Mathematics and Science

Goal 6: Adult Literacy and Lifelong Learning

Goal 7: Safe, Disciplined and Alochol- and Drug-free Schools

Goal 8: Parental Participation

One initiative is the development of curriculum frameworks mapped to more rigorous standards by grade and subject. Developed by teachers, the frameworks for grades K-3 will soon be available. A voluntary pilot project of end-of-course assessments in high schools has been in place for five years and has uncovered wide discrepancies in expectations among the participating schools. The Education Roundtable, according to Orr, is working on a resolution for the state board of education on how to roll out the assessments statewide.

Indiana also has strong first-grade reading diagnostic tests and an unusual test schedule that gives state assessments based on the previous year's standards in the fall "because we believe retention of knowledge is basic." This system also gives teachers timely information to help individual children who need help.

Through a partnership of Purdue University with the North Central Regional Education Laboratory and William Schmidt of Michigan State University, an expert on TIMSS data, the Education Roundtable will analyze the data. One direction is already certain, according to Orr. Algebra, as a precursor for advanced math in high school, needs to be pushed down further into the middle grades.

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MICHIGAN

The comparatively positive results of the state's eighth-grade students on the TIMSS-R tests were "not a surprise" to Michigan officials, according to Charles Allan, math education consultant to the Michigan Department of Education. The upward trends on the state assessment program and national assessment results have been consistent for the past 15 years, he notes, because "we are fortunate to have some very committed people who are also knowledgeable about these subjects." Much of the credit goes to a tradition of collaboration between higher education institutions and local districts.

The initiative to improve math and science instruction partially began with a math professional development project at nine regional sites, primarily university campuses. Using similar formats, the

What is the National Education Goals Panel?

The National Education Goals Panel is a unique bipartisan body of state and federal officials created in 1990 by President Bush and the nation's Governors to report state and national progress and urge education improvement efforts to reach a set of National Education Goals.

Who serves on the National Education Goals Panel and how are they chosen?

Eight governors, four state legislators, four members of the U.S. Congress, and two members appointed by the President serve on the Goals Panel. Members are appointed by the leadership of the National Governors' Association, the National Conference of State Legislatures, the U.S. Senate and House, and the President.

What does the Goals Panel do?

The Goals Panel has been charged to:

- Report state and national progress toward the National Education Goals.
- Work to establish a system of high academic standards and assessments.
- Identify promising and effective reform strategies.
- Recommend actions for state, federal and local governments to take.
- Build a nationwide, bipartisan consensus to achieve the Goals.

The annual Goals Report and other publications of the Panel are available without charge upon request from the Goals Panel or at its web site www.negp.gov. Publications requests can be made by mail, fax, or e-mail, or by Internet.

regional programs offered ongoing professional development to teachers in the districts in their areas. "This got us started," Allan says, "and when the National Science Foundation materials projects came around, Michigan was ready to get into them in a big way."

The shared professional development, in which more than 10,000 teachers participated, was a key to using new materials, he says. Districts in Michigan are free to select their own textbooks, so having a large core of teachers with "fairly good ideas of new directions in content" was important to making a shift to better resources. The new materials, he explains, ask teachers to teach in ways they have never had a chance to learn, so the professional development gave them "opportunities to start to become experts."

Allan also attributes Michigan's progress to a governor who believes in good assessments, noting, "if there is one out there that he thinks is important, we will sign up for it." The assessments inform decisionmaking such as aligning instruction to new materials and preparing curriculum guides. Governor John Engler also has focused attention on five elements for school improvement: a coherent program that aligns content and assessments; use of quality materials; continuous professional development resources; the use of assessment data to make continuous improvement, and strong communication efforts with parents and communities.

On the last point, Allan explains: "We don't want to leave parents with the impression that we are doing binge experiments. We want them to know that there is good thinking behind our efforts."

The Michigan Invitational Group, which participated in TIMSS as a consortium, is a "rag-tag" group of districts, according to Allan, chosen because they were using good materials and pledged to follow the other elements of the governor's criteria. None are affluent, he points out, which was a deliberate decision because "we wanted to make the point that the five criteria are what are important." The Michigan Invitational Group was among the highest performing entities among the TIMSS' benchmarking states and districts.

At a convocation in late April, the governor, legislators, and superintendents across the state will discuss a new project of Achieve, Inc., which Gov. Engler will chair beginning this summer. It has developed world-class expectations in middle-school math, as well as accompanying professional development, classroom strategies, and assessments. "Our message to districts will be to use whatever tests are necessary but to remember that comprehensive efforts are the key," Allan says. "You can measure the pig

RESOURCES

The TIMSS Benchmarking reports are available in full at the International Study Center's web site http://isc.bc.edu

The reports are: *Science Benchmarking Report TIMSS 1999 – Eighth Grade* and *Mathematics Benchmarking Report TIMSS 1999 – Eighth Grade*.

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all you want, but you're not going to make it gain weight."

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OREGON

Benchmarking in public policy is a hallmark for Oregon officials, but improvement of math and science instruction started two decades ago, long before the state adopted benchmarking as a tool for pushing improvement in all facets of public life.

The efforts to improve instruction actually began as a grassroots movement among subject-matter organizations, according to Wayne Neuberger, associate state superintendent for assessment and evaluation. For the last 10 years, the efforts have received state support, but they are still very teacher-based. The state also received a National Science Foundation grant that helped establish a series of statewide networks for math educators. An offshoot was an in-state math center located in Portland, which is now a private organization. Neuberger credits the Oregon Teachers of Mathematics and the Oregon Science Teachers Association with forming networks all over the state and taking leadership to identify needs. They have then been active in creating staff development linked to the needs.

The impetus to participate in TIMSS was a joint effort of the governor, state superintendent, and state board. "They saw it as an opportunity to get a good benchmark, to have another piece of information to analyze," Neuberger says. After National Assessment of Educational Progress results in math become available this summer, "we will have an opportunity to put all of the data on the table—international, national, and our own assessments—and see what they tell us," Neuberger explains. He anticipates the analysis will guide policymakers and educators on professional development and the use of materials developed by the National Science Foundation.

State officials are working closely to improve math and science achievement, he says, and teachers are involved in every step, including content standards development and development of

state assessments.

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