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CONSISTENT, PERSISTENT STATE EFFORTS IN MATHEMATICS REFORM SHOW RESULTS

The availability of good data over time, an emphasis on rigorous standards, and teachers' access to professional development and improved resources - all components of state policies - have contributed to the steady progress in American students' mathematics achievement. The evidence comes from the National Assessment of Educational Progress (NAEP) report of the 2000 math results, showing national as well as state data. The Nation's Report Card: Mathematics 2000 was released earlier this month.

The NAEP math frameworks were first used for a national assessment in 1990 (state data were collected in that year only for grade 8), followed by national and state data collections in 1992, 1996, and 2000. Math scores among 4th and 8th graders show continuous progress over 10 years. In the newly released assessment, 12th graders scored higher than they did in 1990, but fell behind their 1996 scores.

Terming the math 2000 report card from NAEP as "moderately positive," U.S. Secretary of Education Rod Paige noted that "states and districts around the country have paid closer attention to math instruction than reading over the past decade, and these results give us reason to believe that we're on the right track." Yet, he added, the results also indicate that "we have much more work to do to make sure our children have enough math skills" for the nation's leadership needs in the future.

The items on the assessment, given to about 250,000 students, consisted of both multiple-choice questions and those requiring students to provide written responses that explained their answers (constructed-response questions). Students could use calculators on about one-third of the assessment. The frameworks cover five aspects of math: number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability; and algebra and functions.

NAEP reports the results two ways. It reports scores on a scale that runs from 0 to 500, providing averages for overall math performance as well as for students by gender and language background. Results also are reported on the basis of math achievement levels - basic, proficient, and advanced - established by the National Assessment Governing Board (NAGB). These describe what students should know and be able to do. The goal, according to NEGP and NAGB, is for all students to reach the proficient level.

National Results

Student scale scores in grades 4, 8 and 12 were significantly higher in 2000 than in 1990. At the 4th grade students improved from 213 in 1990 to 228 in 2000; 8th grade, 263 to 275; and 12th grade, 294 to 301. Students in both the 4th and 8th grades scored higher than in 1996. At the 12th grade, however, results were mixed. Seniors made progress over the decade, scoring higher in 2000 than in 1990, but their latest average was slightly lower than in 1996.

The scale score analysis also includes the results of students at various levels of performance, or percentiles. These are calculated in five groups - 10th percentile, 25th, 50th, 75th, and 90th (or, the lowest performing to the highest performing). At the 4th grade, students in all five percentile levels increased their scores in 2000 compared to the three previous reports. At 8th grade, students did better in 2000 than in 1990 and 1992 but only students in the 50th percentile showed an increase over the 1996 assessment. At the 12th grade, all five percentile levels showed an increase since 1990, but none increased since 1992. Since 1996, the three lowest levels showed a decline.

The proportion of students in both the 4th and 8th grades improved their achievement of NAGB achievement levels similarly. Fewer 4th-grade students were “below basic” - 31 percent in 2000 compared to 50 percent in 1990. In the same period, the percentage at or above proficient doubled, from 13 percent to 26 percent. The percentage at the advanced level increased from 1 to 3 percent. At the 8th grade, the improvements at each level were very similar.

The 12th-grade pattern on achievement levels was mixed. Students performed better in 1996 than in 1990, rising from 58 percent above basic to 69 percent; this indicator fell to 65 percent in 2000, however. The percentage at or above proficient was higher in 2000 than in 1990 (17 percent compared to 12 percent) and did not decline from the 1996 results.

When examining the scale score results by gender, the achievement of girls and boys followed the patterns of students overall, as did the achievement across the decade by racial/ethnic group. There were some differences in the latter group, however. White students made long-term gains at all three grades; black and Hispanic students made long-term gains at the 4th and 8th grades but not at the 12th grade.

The NAEP math scores show that the score gaps between white students and black and Hispanic students remained substantial throughout the decade and have not changed significantly during the four assessments for any grades. The white-black gap ranges from 31 to 39 points in 2000 across the three grades, and from 24 to 33 points for the white-Hispanic comparison.

State Results

NAEP began collecting state-level data in 1992. The 2000 math assessment included 46 states and jurisdictions at the 4th-grade level; among the 36 states that participated in both the 1992 and 2000 assessments, scores were higher in 26 of them. Of the 39 states that took part in both the 1996 and 2000 assessments, 11 improved their scores; no state or jurisdiction declined.

At the 8th-grade level, state performance was similar among those taking part in the assessment. Of the 31 with data from1992, 27 showed significant gains; none declined. Of the 37 that participated in both the 1996 and 2000 assessments, 13 showed an increase; the remaining 24 showed no change.

General data, however, fail to capture the exceptional progress made by some states. At grade 4, for example, North Carolina students improved their scale scores by 20 points from 1992; the state's 8th-grade students defied the middle-school slump and improved their scale scores from 1990 by 30 points. Other states that improved the most at the 4th grade on the scale scores since 1992 include Texas (up 15 points), and Indiana and Ohio (up 13 points). At the 8th grade, the most improved states include, in addition to North Carolina, Ohio (up 19 points since 1990) and Texas (up 17 points since 1990).

The top performers at the 4th grade include Minnesota, Massachusetts, and Indiana. At the 8th grade, the top performers were Minnesota, Montana, and Kansas (participating for the first time in 2000).

Previous NEGP studies have documented the progress of some of these lead states. Its study of Texas and North Carolina, for example, found a consistent, long-term focus on higher expectations and standards in instruction, strong state accountability, continuous business/community support, and investments in teachers' professional development. A case study of Minnesota, whose students outperformed those in most other countries on the Third International Mathematics and Science Study, showed that a cohesive focus on the same high standards for all students and state support for strong professional standards contributed to its students' success. (see www.negp.gov)

According to Gary Phillips, acting Commissioner of Education Statistics for the National Center for Education Statistics, NAEP's data on background factors related to students' math achievement show several major influences:

* At the 8th-grade level, there is a clear relation between students'

scores and the math courses they took. Those enrolled in pre-algebra performed better in 2000 than those taking "8th-grade math." There is little difference in course-taking between boys and girls but considerable difference between racial and ethnic groups. Blacks and Hispanics are less likely to take first-year algebra than whites and Asian/Pacific Islanders and are more likely to take 8th-grade math. Students at the 12th-grade level who took more demanding courses (e.g., trigonometry, pre-calculus and calculus) scored higher than those taking lower level courses.

* Students whose teachers majored in math or math education tended to have higher scores at the 4th and 8th grades than those whose teachers majored in education or elementary education. At the 8th grade, students whose teachers had taught 11 or more years outperformed those whose teachers had no more than two years' experience. (Seniority provisions, it should be noted, may allow more experienced teachers to choose to work with higher-performing students).
* The regular use of calculators, as reported by teachers, made no difference in the scores of 4th graders, but 8th graders whose teachers reported using calculators at least weekly scored higher than those who used them less frequently.
* The amount of homework did not seem to affect students' scores, but student attitudes toward math did. Students who find math useful for solving problems outperformed those who did not; students who disagreed that math is mostly memorizing facts or that there is only one way to solve a problem scored higher than those who agreed with these statements.

The percentage of students identified in the national sample as disabled increased between 1992 and 2000 from 7 percent to 11 percent at the 4th and 8th grades. The percentage of students identified at the 4th grade as having limited English proficiency increased from 3 percent in 1992 to 5 percent in 2000.

Commenting on the math 2000 report card, eighth-grade math teacher and NAGB member Debra Paulson of El Paso, described some of the gains and the differences as "quite striking." She pointed to the large increase in students meeting the basic level in several states, but noted that the racial gap in scores has increased. Teachers in these states, she said, have focused on teaching and testing for basic skills among the students who are behind. The NAEP scores are a checkpoint for states, she added, because they are independent of state assessment results and reveal how far many states have to go to equalize educational achievement.

In addition to NEGP documentation of some of the highest achieving and most improved states in previous studies, this Monthly notes new states that are making significant progress, including Indiana, Kansas, Ohio, and Montana.

INDIANA

Indiana's 4th grade students had the second highest average scale score in the 2000 assessment, 234, compared to the 226 national scale score average. Its students improved 13 points over 1992, while the national average score improved 7 points. At grade 8, Indiana's students had an average scale score of 283, compared to the national scale score average of 274. The state's average has risen 16 points since the first 8th grade assessment was given in 1990. Indiana's students also have improved considerably on the achievement levels. The percentage of students considered "below basic" at the 4th grade level decreased from 40 percent in 1992 to 22 percent in 2000 (compared to a national average of 33 percent in 2000). At the 8th grade, the percentage of students considered below basic dropped from 44 percent in 1990 to 22 percent in 2000, compared to 35 percent as a national average in 2000.

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

The progress in Indiana reflects the "maturing of efforts" that began in 1989 when the National Council of Teachers of Mathematics released its new standards, according to J. Martin Ball, mathematics consultant for the state Department of Education. At that time, the professional guides in math were revised to include more open-ended questions, performance tasks, and problem solving. "We went out across the state with workshops based on the revised guides," he says. That background prepared teachers for new standards, adopted this year after extensive study of other states' efforts and national reports.

The new standards came from a collaborative process, Ball says. Teachers, state reform groups, and higher education institutions were involved, and the final product retains many of the previous concepts but puts more focus on skills such as numbers and measurement.

In addition, the legislature and the state superintendent worked out a $20 million grant program for teachers. Individual teachers' grants can be used to further their knowledge and skills with the standards. The legislature also said that schools and districts should consider focused professional development as a criterion in performance evaluations. The state department of education is conducting summer "awareness" workshops on the new standards and using educational service agencies to offer school-year workshops that will give teachers hands-on experiences with model practices, especially in integrating math with other core disciplines.

While Indiana is making steady progress, "we don't want people to rest on their laurels," Ball says. "We still have a long way to go."

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KANSAS

Kansas participated in the NAEP math assessment for the first time in 2000, and learned that the state's students were among the top performers at both the 4th and 8th grades. At the 4th grade, the average scale score in Kansas was 232, compared to the national

average scare score of 226. At grade 8, the state's students average scale score was 284 compared to the national average scale score of 274.

Improving math achievement has been a 10-year-effort, according to Kim Gaddis, education program consultant for mathematics improvement in the Kansas State Department of Education. Teachers and curriculum experts began in 1990 working on state math standards, which were adopted by the state board in 1993 and have been through several revisions since. The expectations in the standards are very high for all students, Gaddis says, and although the state assessment system is not high-stakes for students, the results are used as part of a system that pushes for building-wide improvement.

Under a new state school accreditation system, all school buildings are required to target math in their school improvement plans until the students reach "excellence" on the state assessment system. Assessments are given at grades 4, 7, and 10.

The state also provides professional development for teachers in math, primarily through summer institutes, which teachers attend as teams from their schools. There are two follow-up days of professional development related to the content of the institutes, giving teachers a total of eight days of focus on improving math achievement. Moreover, says Gaddis, "we are moving toward results-based staff development, evaluating changes in teachers' instructional practices because of what they learned during the staff development." She estimates that 90 percent of the content of the professional development focuses on improving the problem-solving skills of students.

Another emphasis of the state is on improving reading, and one facet of that is to connect reading skills to improvement in math skills. This is spelled out in more specific benchmarks and indicators adopted by the state board in 1999.

The state assessments are criterion referenced, but school improvement data include more than the state assessment, Gaddis explains. Schools must use the multiple-choice state assessment, a performance assessment, and another assessment of their own choosing.

The next priorities of state leadership in math improvement, Gaddis says, is to explore how to use technology to support state standards, training special education teachers to help their students meet state standards, and providing special support for the lowest performing schools.

In addition, state officials are beginning discussions with higher education institutions about integrating state standards into teacher preparation programs and about the state's goal of revising licensing requirements to reflect the standards.

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RESOURCES

The Nation's Report Card: Mathematics 2000, National Center for Education Statistics, 1990 K Street, NW, Washington, DC 20036
http://nces.ed.gov/nationsreportcard

OHIO

Ohio's students' scale scores increased significantly in grade 4 since 1992 to an average of 231. This was 12 points higher than in 1992. About 26 percent of the students performed at or above the proficient level. At the 8th grade, the average scale score was 283, compared to 264 in 1990. About one-third (31 percent) of the students performed at the proficient level.

The results indicate that "Ohio's long-term commitment to improving mathematics performance of our students is starting to pay off," commented Susan Tave Zelman, state superintendent of public instruction. The Ohio Department of Education introduced a new math curriculum in 1991, which local districts have used to guide their own curriculum revisions. Also, the current Ohio Proficiency Tests in math focus on knowledge levels similar to NAEP, according to Zelman, including conceptual understanding, procedural knowledge and skills, and application and problem solving.

In addition, the Ohio Council of Teachers of Mathematics has been involved significantly in developing the standards for the math curriculum, in conducting professional development for teachers to help them begin to use the new curriculum, and more recently in writing new academic content standards in math. The math standards are ready for presentation to the state board.

The state education department also helped form four regional consortia of 10 to 20 school districts each that will work together over a five-year project to achieve world-class student achievement in math and science. The consortia are using the findings of TIMSS to improve their curriculum and instruction. Furthermore, the state has continued the activities started under a State Systemic Initiative grant from the National Science Foundation that focused improvement efforts on the middle grades. It is expanding the activities to span kindergarten through higher education institutions.

According to Zelman, Ohio students' progress is largely due to state efforts to align clear expectations with curriculum and instruction.

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MONTANA

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.

At the 4th\grade, Montana students achieved a scale score of 230 in 2000, compared to the national average of 226, and several points above their 1996 average (the first year they participated). At the 8th grade, the students achieved an average scale score of 287, seven points higher than their 1990 average. Also, 32 percent of the 8th graders were at the proficient level in 2000, compared to the national average of 21 percent.

Improving math achievement throughout the state "is like a barn raising," according to Judy Snow, director of the Division of Measurement and Accountability at the Montana Office of Public Instruction. "Everyone gets involved." Teachers and parents have worked with math experts to develop strong math standards, she says. The six strands correspond to widely accepted national standards and emphasize problem solving. They have been in place since 1998. In addition, the Montana Council of Teachers of Mathematics has been working on developing state performance standards that are aligned to the content standards. As districts revise their curriculum in math, they will be integrating the state standards, she says.

The standards coordinate well with NAEP's emphasis on problem solving, working with contexts, and reading and thinking skills, Snow says. While the state's assessment is not yet in place, she expects it to reflect these skills and to include performance assessments.

Most professional development is conducted by the districts, Snow points out, but the professional links for teachers across the state make it possible to coordinate resources for teachers and keep a focus on the standards. The state and the district "try to keep class sizes down" to improve the environment for learning, she adds.

Through outside grants, the state's higher education institutions are now focusing on aligning teacher preparation to the standards and to performance assessments.

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