News Release

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International Math-Science Comparison Finds U.S. Better in Science But in the Middle Overall; Not Good Enough, Riley Says

According to the most thorough international study of math and science education ever conducted, U.S. students are above average in science and below in math.

Pursuing Excellence: A Study of U.S. Eighth-Grade Mathematics and Science Teaching, Learning, Curriculum and Achievement in International Context, released today by the U.S. Education Department's National Center for Education Statistics, reports U.S. scores in both math and science as not significantly different from those of England or Germany. In science, among participating G-7 countries -- America's major economic and political allies -- only Japan scored significantly higher than the U.S. [G-7 countries include the United Kingdom, Canada, France, Germany, Japan and Italy. Italy did not participate in the test.]

Overall, American students are above average in life sciences and environmental issues, average in fractions, algebra and physics, but struggle with measurement and geometry.

"If we see the news in the report as simply a horse race story of who finished first and who finished second we miss the point," said U.S. Secretary of Education Richard W. Riley. "The issues are much deeper -- the content and rigor of what we are teaching -- how we go about teaching -- the fact that we continue to shortchange America's teachers by not giving them the preparation and help they need to do the best job possible in the classroom. One of the clear messages of this report is that we need to take a good, hard look at what we teach and how we teach math."

Among the findings drawn from the Third International Mathematics and Science Study (TIMSS):

•eighth-grade mathematics classes in the U.S. are not as advanced and not as focused as those in Japan and Germany;

•topics taught in U.S. eighth-grade mathematics classrooms are at a seventh-grade level by international standards;

•the content of U.S. mathematics classes requires less high-level thought than classes in Germany and Japan;

•U.S. mathematics teachers' typical goal is to teach students how to do something, while Japanese teachers' goal is to help them understand mathematical concepts.

The international comparison suggests a general improvement in U.S. science from a 1991 assessment that placed American students below average, though the tests and the set of participating nations have changed. U.S. mathematics performance, however, remains slightly below the international average.

"Our own National Assessments of Educational Progress show our students have improved in

math since the early '80s," Riley said, "but it appears students in other nations are moving up, too. For U.S. students, average is just not good enough."

Riley said states and local school districts should review and toughen their academic standards, and cited materials prepared by the National Council of Teachers of Mathematics as an example of how to improve the teaching of math.

According to the report, U.S. teachers are generally familiar with the tougher standards suggested by the council, but it appears that other nations, notably Japan, are doing a better job of actually teaching tougher material. Based on videotapes of actual classroom instruction, the researchers found that U.S. math classes still largely focus on how to solve problems, while Japanese teachers do a much better job at helping students understand the concepts behind the solutions.

Riley said the department will sponsor a series of regional and state workshops on the results of the study, with an emphasis on successful practices that illustrate more rigorous content and teaching methods. Riley also said the department will prepare and send a summary of the report to business and education leaders and the nation's local PTA chapters. The department also will work with communities and states, as well as the National Science Foundation, the National Academy of Sciences, and the nation's math and science teachers to share what works to boost achievement.

The study found that common culprits such as television watching and lack of time devoted to study could not account for the below average U.S. math scores. Heavy TV watching was found to be about as common in Japan -- one of the highest scorers -- and U.S. students actually spend more classroom time on math and science than students in both Japan and Germany.

"The data appear to be telling us that we need to examine what's actually going on in the school and the classroom," Riley said. "We have bright, dedicated, well-educated teachers, but compared to Japan and Germany, they get little practical training or mentoring, and little opportunity to work closely with other teachers to improve teaching."

Riley said colleges and universities should examine how teachers are prepared and suggested that guidelines from the National Commission on Teaching and America's Future be considered as a "blueprint" of how to proceed. The commission has called for high standards, more opportunities for apprenticeships, mentoring by master teachers and work schedules that permit ongoing professional development.

Riley also stressed that improving how we train teachers "will be of little use if teachers are forced to teach using textbooks that are outdated, lack focus, and do not reflect the tougher standards."

"Every student should enter middle school and junior high school with a firm grasp of arithmetic," Riley said, "but clearly employers want problem solvers, people who have mastered the basics and can apply that knowledge to new situations. Our math curriculum in middle schools and junior high schools lacks focus and too much class time is spent memorizing formulas at the expense of understanding useful concepts.

"Many of our students have not even been exposed to the material on this test, for example basic geometry and physics, by the eighth grade. Rather, they see the same content over and over again, year after year. It's time to re-examine what we ask of students and raise the bar -- do away with dead-end, general math classes. We can do better."

Other findings in the TIMSS report include:

•There was little difference in how U.S. boys and girls scored in both math and science;

•Japanese teachers have more opportunities to discuss teaching-related issues with their colleagues than do U.S. teachers;

•U.S. teachers assign more homework and spend more class time discussing it than teachers in Germany and Japan. U.S. students report about the same amount of out-of-school math and science study as their Japanese and German counterparts;

•U.S. teachers generally receive more formal education, but not as much hands-on training and daily support for quality teaching as their Japanese colleagues;

•Although most U.S. math teachers report familiarity with reform recommendations, few apply the key points in their classrooms.

•Additional TIMSS reports, examining the math and science achievement of fourth- and 12-grade students, are being prepared. In all, nearly 500,000 students participated in TIMSS -- 40,000 in the U.S.

•The report is available on the department's web site at www.ed.gov/NCES/timss. Printed copies are available while they last from the National Library of Education at 1-800-424-1616 (in D.C., 219-1651). The report also will be available from the U.S. Government Printing Office.

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Remarks by

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DIRECTOR
NATIONAL SCIENCE FOUNDATION

At a Press Conference to Release Student Achievement Results of the Third International Mathematics and Science Study

November 20, 1996

(As delivered)

In reviewing the data from the Third International Mathematics and Science Study, one obvious question that arises is "What are the surprises?" The most obvious answer, it seems to me, is that there really are none.

I wish there were. We, as a nation, are short of pleasant surprises when it comes to science and mathematics education.

Unfortunately, what the data tell us is that given the kinds of activities and learning that commonly take place in most American classrooms without substantial changes, the U.S. is unlikely to achieve its national education goal of becoming first in the world in math and science. We simply cannot afford to fail to meet that challenge.

Put another way, maintaining the status quo locally simply will not put us on the leading edge globally.

This worries me. It should worry us all.

Education is an important part of NSF's mission. We support an array of research into effective practice at all levels of the educational system. Our most ambitious efforts are to reshape K-12 science and math education in whole states and major urban areas nationwide. Many of the basic commitments that we require from those who wish to participate in these "systemic" initiatives echo the "best practices" of high-achieving nations in the TIMSS study.

For example, if all students, not just a select few, are asked to master challenging math and science content--if the bar is set high enough, if you will--we find that all students will, in fact, strive to achieve at the higher level.

If the school day is reconfigured and the curriculum refocused so that teachers are adequately supported and are given the time to teach well, and in-depth, and are encouraged themselves to continually improve their skills and knowledge, then both students and teachers benefit.

If students are grouped according to the expectation that some can learn challenging math and science and others cannot, then those expectations are likely to be fulfilled. Fortunately, as we have found in many of our "systemic" reform sites--from Detroit to Louisiana to Puerto Rico--the opposite also is true. All students can rise to the challenge. Indeed, we cannot expect them to do well unless they are challenged.

From *A Splintered Vision*, a report which NSF released last month here as part of TIMSS, we discovered that the 8th grade U.S. curriculum, when compared with curriculums abroad, lacks focus and is packed with information, almost guaranteeing that no one topic can be taught in depth. We also learned that U.S. teachers have far less time to think about what they teach and how best to teach it.

Today, we may infer from the TIMSS achievement findings that this classroom cacophony is in large measure responsible for the middling U.S. TIMSS results.

As a physicist, I find it disturbing that mathematicians who reviewed videotapes of U.S. math lessons saw essentially no high quality math taught at all. Sadly, they found, in fact, that 87 percent of the math taught was of low quality.

By way of comparison, 30 percent of the math taught by Japanese teachers and 23 percent of the math in the Germany lessons was deemed high quality. Only 13 percent of the math taught in the Japanese lessons was judged to be of low quality. That is an extraordinary spread in how mathematics is taught.

I don't think it's surprising, then, that although U.S. students place around or above the international average in subjects like environmental science, they are far from standouts when it comes to the so-called "hard sciences" of chemistry and physics--those solidly grounded in math--exactly the kinds of subjects they should be mastering.

Teachers and students alike should be expected to, and permitted to, "exercise their minds." Too often, they are rewarded for being intellectual "couch potatoes."

We also must conclude from *A Splintered Vision* and these most recent findings that U.S. students reap the consequences of our failure to put a premium on good teaching.

One seemingly trivial demonstration of this lack of respect and support for teachers stands out in my mind. Although the TIMSS report does not examine the impact of technology on learning, I joked recently that at least one technological advance definitely is hindering learning here in the U.S. In viewing the TIMSS videotapes, the researchers were struck by the fact that the voice from the classroom loudspeaker, blaring out in the midst of teachers' lessons, was the single most intrusive problem in the classroom.

A country that respects and dignifies the teaching profession simply could not and would not allow this to happen. And it doesn't take money to fix it.

TIMSS is a baseline against which future studies can be judged. We at NSF know a lot about what works in the classroom and have begun to accumulate evidence to support those conclusions. We are happy to share the lessons we've learned.

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