THE WHITE HOUSE

WASHINGTON

March 14, 1998

PRESIDENTIAL MEETING ON MATH AND SCIENCE EDUCATION

DATE:	March 15, 1998
LOCATION:	Springbrook High School
BRIEFING TIME:	9:30 am - 10:00 am
EVENT TIME:	10:30 am - 11:50 am (meeting)
	12:00 pm - 12:45 pm (remarks to students)
FROM:	Bruce Reed/Mike Cohen

I. PURPOSE

To bring together leaders from government, business, education, and the scientific community to discuss the recent 12th grade Third International Math and Science Study (TIMSS) results, and to issue a set of challenges to the nation to improve student achievement. You will also announce new on-line math and science help for parents, teachers, and students.

II. BACKGROUND

You will be meeting with 25 leaders from government, business, education, and the scientific community to discuss how the nation should respond to recent findings from the Third International Math and Science Study (TIMSS) that while U.S. 4th graders are near the first in the world in science and above average in math, U.S. 12th graders lag below the international average in both subjects.

These results demonstrate the importance of implementing your education agenda, including proposals for: national standards and tests in math and reading, smaller classes with well-prepared teachers, modern school buildings, Education Opportunity Zones to end social promotions and fix failing schools, technologically advanced schools, and "High Hopes" mentoring to encourage students to take tough classes and prepare for college.

<u>In addition to reiterating your legislative proposals, you will issue the following new challenges to boost student achievement in math and science.</u>

- **Reducing out-of-field teaching**. You will challenge states and school districts to reduce the percentage of math and science teachers without a major or minor in their subject area. The average K-8th grade math teacher takes only three undergraduate math courses. Twenty-eight percent of secondary math teachers lack a major or minor in their subject area, as do 18% of secondary science teachers and 55% of physics teachers.

- **Rigorous Tests for New Teachers**. You will challenge states to require all new

teachers of math and science to pass challenging tests of math or science knowledge and teaching proficiency. With nearly half of our nation's teaching force to be replaced over the next several years in order to accommodate growing student enrollments and an aging teaching force, raising standards of teaching now can boost the quality of our schools for decades.

- **A Call to Action for Schools, Students, and Parents.** You will challenge schools to offer -- and students to take -- tough math and science courses throughout middle school and high school. Only 25% of U.S. students take algebra before high school, and only 25% of U.S. high school students take physics before graduating. You will challenge parents to insist that school districts provide ways of showing how children are doing compared to national standards and international benchmarks. Today, parents have no way of finding out how their children do compared to the international standards in TIMSS.

You will also announce the following new on-line resources for parents, students, and teachers:

- **"Federal Resources for Educational Excellence" (FREE) Web-site.** A new website is available today to connect teachers, parents, and students to teaching and learning resources in math, science, and other subject areas from NASA, the Energy Department, the National Science Foundation, and other agencies.

- **The TIMSS On-Line Challenge.** The U.S. Department of Education will launch this fall a website that puts TIMSS math and science problems on-line. This will enable parents to give a quiz to their children, learn what their children should know in math and science, and learn how their children are doing compared to students from other countries.

Summary of the TIMSS Results:

TIMSS showed that U.S. 12th graders scored among the lowest of 21 nations in general math and science, with the U.S. outperforming only Cyprus and South Africa. Performance of U.S. 12th graders in advanced math and physics courses also lagged behind their peers from other nations. The 12th grade findings completed a multi-year study showing U.S. 4th graders near the first in the world in science and above average in math, with U.S. 8th graders slightly above the international average in science and below the international average in math. The 21 nations participating in the 12th grade study were the U.S., Canada, Australia, and many European nations. No Asian countries participated in the 12 grade tests. (See attachment of how the U.S. ranks compared to each participating country for all three grades.)

While there is not yet an analysis of the 12th grade TIMSS, an analysis was done of the 8th and 4th grade TIMSS. The analysis found that U.S. curriculum was less advanced, and that it covered more subjects superficially rather than a few subjects in depth. The analysis also showed that U.S. teachers often do not get as much training as those in other nations.

Although other tests (including the National Assessment of Educational Progress) show that U.S. student achievement is improving, TIMSS makes clear these improvements are not rapid enough to keep pace with other nations in an increasingly global economy.

Springbrook High School

Springbrook High School is a good school with above-average test scores. Although the school has a solid math and science program, it is not particularly stronger than any of the other academic areas taught in the school. Springbrook has a very diverse student body (35% African American, 20% Asian, 16% Hispanic, 28% white), and it enrolls a total of 2,200 students.

[**NOTE**: Last week Springbrook High School held its first Anti-Violence Week, to honor one Springbrook student and one former student who were killed within the last year. Former Springbrook student Alfredo Enrique Tello, Jr. was brutally killed at age 19. Samuel Sheinbein (who fled to Israel) and Aaron Needle are charged with the murder. Two months later a Springbrook student Elmer Flores was killed in a robbery.]

III. PARTICIPANTS

Briefing Participants:

Secretary Riley
Secretary Pena
Bruce Reed
Rahm Emanuel
Mike Cohen

Event Participants:

Secretary Richard Riley
Secretary Federico Pena
Governor Parris Glendening, Maryland
Governor Cecil Underwood, West Virginia
Mayor Richard Daley, Chicago, IL
Mayor Richard Riordan, Los Angeles, CA
Mayor Lee Clancey, Cedar Rapids, IA
William Schmidt, National Coordinator for TIMSS, Professor, Michigan St. University
Rudy Crew, Chancellor of New York City Schools
Diane Ravitch, Former Assistant Secretary of Education in the Bush Administration. Currently, a Senior Fellow at Brookings and Research Professor at New York University.
Bruce Alberts, President of the National Academy of Sciences
Neil Lane, President of the National Science Foundation
Bill Nye, Host of Weekly Television Show,"Bill Nye The Science Guy"
Alan Wurtzel, Vice Chairman of the Board, Circuit City
Wilmer Cody, Chair of the Chief State School Officers and Commissioner of Education in Kentucky
Robert Moses, Director of the Algebra Project, which helps disadvantaged students prepare for rigorous math classes
Bob Chase, NEA President

Sandy Feldman, AFT President
Nancy Grasmick, Superintendent of Schools, Maryland
Migues Nevarez, President of University of Texas Pan American
Walter Secada, Professor of Math and Science Education at the University of Wisconsin, and Director of the Department of Education Regional Comprehensive Assistance Center
Cindy Mayorga, Springbrook High School Student
Cyrus Ishikawa, Springbrook High School Math and Physics Teacher
Congresman Wynn
Senator Sarbanes

IV. PRESS PLAN

MEETING: Pool Press for Opening Statement. Meeting is then Closed Press.
SPEECH: Open press remarks before the student body.

V. SEQUENCE OF EVENTS

- **YOU** will be greeted at the school by Principal Mike Durso, Governor Glendening, Superintendent of Schools Nancy Grasmick, and Members of Congress.
  *You will also be greeted by Michael Cohen's son, Ross, who attends Springbrook.
- **YOU** will enter the media center and take your seat at the table. (All other participants will already be seated.)
- The Pool will enter the room.
- **YOU** will make a statement to the press and invite Secretary Riley to make remarks.
- Sec. Riley will make remarks and introduce Bill Schmidt, TIMSS Nat'l Coordinator.
- Bill Schmidt will briefly review the TIMSS findings, then the pool will depart.
- **YOU** will begin the meeting by calling on Secretary Pena to briefly describe the Energy Department's commitment to Science education.
- **YOU** will then open the meeting by calling on each participant to speak. Each participant will give a brief statement on their view of the improvements that can be made in math and science education, and you are free to respond. (**YOU** should begin by calling on the Governors and Mayors present.)
- 10 minutes prior to the close of the meeting Bill Nye will depart to the auditorium, where he will do a brief pre-program for the students.
- Secretary Riley will help bring the meeting to a close.
- **YOU** will thank participants and then depart.

Speech to the Student Body:

- **YOU** will be announced onto the stage accompanied by the school Principal and Secretary Riley.
- The Principal will make brief remarks and introduce **YOU**.
- **YOU** will make remarks.
- **YOU** will work a ropeline, and then proceed to the overflow room.
- **YOU** will make very brief, informal remarks, and then depart.

VI. REMARKS

Provided by Speechwriting.

DISCUSSION POINTS FOR EDUCATION MEETING

(1) Improving performance is critical to U.S. economic growth and individuals personal opportunities

- Most of the highest growth areas in our economy are in areas that require strong math and science skills (e.g., information technology, health professions, systems analysts, engineers).

- Almost 90% of new jobs require more than a high school level of literacy and math skills.

- For students to get on the road to college and high paying jobs, math and science skills are critical. Students who take algebra and geometry go to college at much higher rates (83% vs. 36%) than those who don't.

(2) We must have higher standards and expectations in middle and high school mathematics and science.

- In grades 4-8, students in other nations are studying algebra, geometry and other topics, while U.S. students continue to be taught primarily arithmetic.

- The content taught in U.S. eighth-grade mathematics classrooms is generally at a seventh grade level compared to the 40 other nations in the TIMSS study.

- A recent international comparison of science and math examinations for college-bound students by the AFT shows that our SAT, ACT, and AP exams are much less rigorous than similar exams from other nations.

- The standards of state assessments vary widely, and many 8th grade mathematics assessments are less rigorous than the NAEP standards. The voluntary national tests will help address this.

(3) Students should take four years of rigorous high school mathematics and science.

- Only 25% of U.S. high school students take physics and only 10% take calculus. Most students do not take four years of high school mathematics and science. Even among college bound students, less than half do so.

- Businesses can demonstrate the importance of a rigorous course of study by looking at student transcripts when making hiring decisions. The U.S. Chamber of Commerce, the National Alliance of Business, and the Business Roundtable are encouraging employers to do this.

(4) U.S. curriculum should be more focused, instead of covering more subjects superficially.

- At 8th grade, U.S. mathematics and science curriculum is less focused than that of other nations --"a mile wide and an inch deep."

- The typical U.S. 8th grade mathematics textbook covers 35 topics while the typical Japanese 8th grade textbook covers 7.

(5) **Teachers must be prepared to teach challenging math and science.**

- The average K-8 teacher of mathematics takes only 3 undergraduate math courses. In high school, in 1993-94, 28% of mathematics teachers, 18% of general science teachers and 55% of physics teachers were teaching out-of-field, meaning that they have neither a major nor a minor in the subject they teach.

- TIMSS found that in a typical U.S. classroom, students are drilled to learn how to repeat how the teacher solves a problem. In Japan, students are asked to solve problems and then present their methods and solutions to the class in order to increase their own understanding.

- This is why it is essential that states require new teachers to take rigorous tests of their knowledge and skills, that states and districts reduce the number of out-of-field teachers, and that colleges and universities commit to recruiting and preparing more top-notch math and science teachers.

(6) **Our students do not start behind, they fall behind.**

- In comparison with students in other nations U.S. 4th graders students are above average in mathematics and second only to Korea in science.

- The strong performance of the "First in the World Challenge" districts north of Chicago show that with the right effort, our students can be first in the world.

(7) **U.S. achievement in mathematics and science is improving, but not fast enough.**

- The achievement of U.S. students has improved in the last decade as shown by higher scores on the NAEP, SAT, and ACT.

- TIMSS and other international assessments show that other nations are also improving. Thus, to improve our relative international standing and remain competitive in the increasingly global economy, we must redouble our efforts.

(8) **U.S. students are mastering the basics of computation but have troubles with more advanced content and skills**

- Both NAEP and TIMSS show that our students do well in the basics of computation. 79% of 8th graders can add, subtract, multiply and divide.

- Our students have trouble with more advanced content (geometry, measurement, algebra) and with solving multi-step problems.

(9) **We must destroy the myth that math and science are only for a few students.**

- Surveys show that about half of middle and high school students say they will drop math and science as soon as they are able to -- even if they want to go into fields such as engineering or medicine that require math and science knowledge.

12th GRADE TIMSS RESULTS

MATH PERFORMANCE

Top Tier
Netherlands
Sweden
Denmark
Switzerland
Iceland
Norway
France
New Zealand
Australia
CanadaAustria
Slovenia
Germany
Hungary

Middle Tier
Italy
Russian Federation
Lithuania
Czech Republic
United States

Low Tier
Cyprus
South Africa

SCIENCE PERFORMANCE

Top Tier
Sweden
Netherlands
Iceland
Norway
Canada
New Zealand
Australia
Switzerland
Austria
Slovenia
Denmark

Middle Tier
Germany
France
Czech Republic
Russian Federation
United States
Italy
Hungary
Lithuania

Low Tier
Cyprus
South Africa

MATH PERFORMANCE (ADVANCED STUDENTS)

Top Tier
France
Russian Federation
Switzerland
Australia
Denmark
Cyprus
Lithuania
Greece
Sweden
Canada
Slovenia

Low Tier
Italy
Czech Republic
Germany
United States
Austria

SCIENCE PERFORMANCE (ADVANCED STUDENTS)

Top Tier
Norway
Sweden
Russian Federation
Denmark
Slovenia
Germany
Australia
Cyprus
Latvia
Switzerland
Greece
Canada
France Czech Republic

Low Tier
Austria
United States

4TH AND 8TH GRADE TIMSS RESULTS

4TH GRADE MATH

Top Tier
Singapore
Korea
Japan
Hong Kong
Netherlands
Czech Republic
Austria

Middle Tier
Slovenia Ireland
Hungary
Australia
United States
Canada
Israel

Low Tier
Latvia
Scotland
England
Cyprus
Norway
New Zealand
Greece
Thailand
Portugal
Iceland
Iran
Kuwait

4TH GRADE SCIENCE

Top Tier
Korea

Middle Tier
Japan
United States
Austria
Australia
Netherlands
Czech Republic

Low Tier
England
Canada
Singapore
Slovenia
Ireland
Scotland
Hong Kong
Hungary
New Zealand
Norway
Latvia
Israel
Iceland
Greece
Portugal
Cyprus
Thailand
Iran
Kuwait

8th GRADE MATH

Top Tier
Singapore
Korea
Japan
Hong Kong
Belgium
Czech Republic
Slovak Republic
Switzerland
Netherlands
Slovenia
Bulgaria
Austria
France
Hungary
Russian Federation
Australia
Ireland
Canada
Belgium-French
Sweden

Middle Tier
Thailand
Israel
Germany
New Zealand
England
Norway
Denmark
United States
Scotland
Latvia
Spain
Iceland
Greece
Romania

Low Tier
Lithuania
Cyprus
Portugal
Iran
Kuwait
Colombia
South Africa

8th GRADE SCIENCE

Top Tier
Singapore
Czech Republic
Japan
Korea
Bulgaria
Netherlands
Slovenia
Austria
Hungary

Middle Tier
England
Belgium
Australia
Slovak Republic
Russian Feeration
Ireland
Sweden
United States
Germany
Canada
Norway
New Zealand
Thailand
Israel
Hong Kong
Switzerland
Scotland

Low Tier
Spain
France
Greece
Iceland
Romania
Latvia
Portugal
Denmark
Lithuania
Belgium-French
Iran
Cyprus
Kuwait
Colombia
South Africa

PARTICIPANTS IN MEETING ON MATH AND SCIENCE EDUCATION

Secretary Richard Riley
Secretary Federico Pena
Governor Parris Glendening, Maryland
Governor Cecil Underwood, West Virginia
Mayor Richard Daley, Chicago, IL
Mayor Richard Riordan, Los Angeles, CA
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Alan Wurtzel, Vice Chairman of the Board for Circuit City, and Chair of the National Alliance of Business Task Force on Education Standards
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Migues Nevarez, President of University of Texas Pan American
Walter Secada, Professor of Math and Science Education at the University of Wisconsin, and Director of the Hispanic Dropout Project
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Cyrus Ishikawa, Springbrook High School Math and Physics Teacher
Congresman Wynn
Senator Sarbanes

4. The New York Times

02/25/98Section: National Desk; Section B; Page 10, Column 1

U.S. Trails the World in Math and Science

By ETHAN BRONNER

The most comprehensive and rigorous international comparison of schooling ever undertaken reveals American high school seniors to be among the industrial world's least prepared in mathematics and science, prompting educators and political leaders, including President Clinton, to call for a re-examination of the nation's approach to teaching quantitative skills.

Particularly devastating, the American officials said, was the bleak performance of the best American students in advanced subjects. In physics and advanced mathematics, not one of the countries involved — including less well-off nations like Greece, Cyprus and Latvia — scored lower than the United States.

"This study has burst another myth," said William H. Schmidt, an educational statistician from Michigan State University who coordinated the American portion of the study. "Our best students in mathematics and science are simply not world class. Even the very small percentage of students taking Advanced Placement courses are not among the world's best."

The results seemed particularly jarring given the continuing dominance of the United States in a global economy based increasingly on information and technology. Some wondered whether American colleges and universities were making up for the gaps.

The data, released yesterday, are from the Third International Mathematics and Science Study, which in the spring of 1995 tested samplings of 4th, 8th and 12th graders. More than 40 countries participated in the 8th-grade portion and about half that number in each of the other two sections. The Asian nations, traditional high performers, did not take part in the high school portion.

The fourth-grade results, released in June, showed the United States to be above the international average and were hailed as evidence that the attention paid in recent years to improving schools was paying off.

The eighth-grade results, released seven months earlier, had raised some concern because Americans dipped below the international average in mathematics although they scored above it in science.

But the latest results, for high school seniors, are being greeted with shock and dismay by large numbers of educators and officials who see them as evidence of a fundamental national failing.

"There is something wrong with the system and it is our generation's responsibility to fix it," President Clinton said yesterday in response to the results of the study. "You cannot blame the schoolchildren."

Education Secretary Richard W. Rileysaid the results confirmed what the Administration has been saying: that the country needs clearer, firmer academic standards and better prepared science teachers.

Conservative lawmakers have opposed the national tests on grounds that they would represent a centralization of education, which they view as more properly controlled locally.

While versions of the international study in the 1960's, 70's and 80's produced equally poor results for American high schoolers, they were largely discounted because of perceived societal and educational differences between the United States and other countries. This time, officials say the differences have narrowed, and those that remain were statistically accounted for.

Those who carried out the study said there were no clear or simple explanations for the low level of American performance. "It is not class size or homework or social life or television," said Ina V. S. Mullin of Boston College, co-deputy director of the study. "Around the world, everybody watches television."

The examination given to the 12th graders consisted of four parts: general mathematics, which includes fractions and percentages, graphics and some algebra; general science, which includes earth science, life science and physical science; advanced mathematics, which includes calculus, geometry and equations, and physics.

Students were selected to represent their nations; 23 countries participated in some part of the exam. To account for margins of error, results were clustered into groups.

In general knowledge of mathematics, American 12th graders did better than those in only two countries, Cyprus and South Africa. Students in four countries, Italy, Russia, Lithuania and the Czech Republic, performed at the same level as those in the United States. Fourteen countries outperformed America, led by the Netherlands and Sweden. The results were similar for science.

The advanced mathematics assessment was given to students who had taken or were taking pre-calculus, calculus or Advanced Placement calculus, and the advanced physics assessment to students who had either taken or were taking physics or Advanced Placement physics. In advanced math, 11 countries outperformed the United States and no country performed more poorly; in physics, 14 countries did better than the United States and none did worse.

One ray of light was performance by American students who took Advanced Placement calculus. When these students — about 5 percent of those in the nation — were separated out and measured against students abroad in advanced mathematics, they did slightly better than the international average. But in physics, when the same statistical exercise was done, Americans were still below the international average.

One of the nagging problems worldwide seen in the study was a sex gap favoring boys in math and science. Boys significantly outperformed girls in mathematics and science in all 21 countries tested in the fields except Cyprus, South Africa and the United States.

Pascal D. Forgione Jr., the United States Commissioner of Education Statistics, said that previous explanations for the country's comparatively poor performance no longer held true. In the past, Mr. Forgione said, other countries tended not to keep the less academically

1. The Atlanta Constitution
03/10/98Section: EDITORIAL; Page A;08

Give national tests a try

Here's a simple problem: Take a country that opposes national education standards, add superficial curricula created by committee and what do you get?

The answer: American 12th-graders scoring near the bottom of the industrialized world in a major international mathematics and science test.

The disheartening performance of U.S. students in the **Third International Mathematics and Science Study** proves that local control has amounted to endorsed failure in our schools.

The national testing proposed by President Clinton is essential to set academic benchmarks by which all of America's schools could gauge their performance. The testing could also serve as an early-warning bell for schools that are falling behind. In math and science, that alarm bell has already been sounded. High school seniors in the United States trailed their counterparts in most countries, outperforming only Cyprus and South Africa. In advanced mathematics and physics, no country was worse.

Oddly, the GOP response to the dismal showing has been to criticize any attempts at national reforms, urging instead that initiatives be left to local school districts.

But that may well be the source of the problem. Unlike high-scoring European students who follow a national curriculum designed by the experts, the United States relies on local districts to determine what will be taught. The result is a splintered approach to teaching the crucial math and science skills that will enable American students to compete in an increasingly technological economy.

According to Michigan State University researchers, incoherence of curricula is the most important factor in America's underperformance, not teachers, homework or school financing. The United States actually spends more education dollars per capita than other countries. The researchers found that U.S. curricula suffer from a laundry list of topics, lack of depth in key areas and repetitive, unchallenging material. In context, it must be noted that although America has had a history of ignoble standings in international measures of math and science, the United States has also emerged as the undisputed pacesetter in the global technology market. That's because a small fraction of the 3 million students graduating each year are well prepared to flourish in the new information age. But math and science literacy can no longer be limited to future engineers. In our information-driven world, virtually all workers must have the skills to master computers. The disappearance of high-paying, low-skilled factory jobs means that today's generation of high school dropouts could earn less than their fathers and even their grandfathers.■

COMMENTARY

57. The New York Times

03/02/98Section: Editorial Desk; Section A; Page 17, Column 1

Low Scores Are No Disgrace

By Howard Gardner

CAMBRIDGE, Mass. — The dismal performance of American 12th graders on the Third International Mathematics and Science Study is naturally disheartening. Even in a pool that lacked the usual high-scoring Asian countries, American students managed to score near the bottom.

But we should resist the tendency to focus on increasing our students' scores on these tests. These tests don't measure whether students can think scientifically or mathematically, they just measure a kind of lowest common denominator of facts and skills. So getting students to do well on them doesn't necessarily mean much in the real world. It doesn't even mean that students will have successful careers in science and technology.

Half a dozen years ago, when our economy was languishing along with our test scores, it was easy to blame our poor schools and to push for better results from our students. Now the United States stands at the top of the world economically, but our students are still scoring at the bottom on international math and science tests. Since high scores on these tests obviously aren't crucial to our economic success, we need to decide what kinds of tests matter in helping form the kind of citizen we want to have.

Standardized tests should find out if American students can think in a scientific manner. That means teaching students to understand the nature of the scientific method: how experiments are set up, how models and theories are constructed and tested, how to decide what theories best describe a phenomenon. Students learn those concepts only by designing and carrying out their own experiments.

Tests should measure a student's scientific ability by presenting a problem, offering data to solve that problem and positing several different interpretations of the data. The test taker might be asked to determine what conclusions can and cannot be drawn.

But most standardized tests ask fact-based questions that sample a wide range of topics in a somewhat superficial way. Students who score well on these tests are like well-trained athletes or musicians: through practice, they have become proficient at a certain skill — in this case, they have done extensive problem sets in many different "content areas" and can move quickly from one question to another.

These tests are helpful in the real world, especially in high school and college. But they simply do not show whether a student can think seriously about a scientific issue. We could drill our students with problem sets and raise their test scores, but still be left with a population that remains scientifically and mathematically challenged.

After all, students should be able to apply scientific and mathematical concepts to the world around them. As adults, they need to know how to decide which life insurance to buy, how pesticides affect their food and how interest rates determine home mortgages. Citizens also need to be able to decide whether cloning research should be banned, whether more money should be poured into studying global warming and whether there should be a national health care plan.

Aren't these skills ultimately important for our nation and others, too? We must rethink the way we teach science and math. We must have the foresight to pursue a less traveled road, one that can lead to a citizenry that can think rigorously and make informed decisions and that can handle a future where science and technology will be more important than ever.■

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February 25, 1998, Wednesday, Final Edition

SECTION: OP-ED; Pg. A17

LENGTH: 905 words

HEADLINE: Put Teachers to the Test

BYLINE: Diane Ravitch

BODY:

Last summer, a suburban school district in New York advertised for 35 new teachers and received nearly 800 applications. District officials decided to narrow the pool by requiring applicants to take the 11th-grade state examinati in English. Only about one-quarter of the would-be teachers answered 40 of the 50 multiple-choice questions correctly.

As Congress considers reauthorization of the Higher Education Act, teacher education has emerged as a major issue. Many states -- and now President Clint -- are clamoring to reduce class size, but few are grappling with the most important questions: If we are raising standards for students, don't we also need to raise standards for teachers? Shouldn't state and local officials make sure that teachers know whatever they are supposed to teach students?

Almost every state claims that it is strengthening standards for students, but the states have been strangely silent when it comes to ensuring that teachers know what they are supposed to teach. Most instead certify anyone wit the right combination of education courses, regardless of their command of the subject they expect to teach, and many states require future teachers to pass only a basic skills test.

Today, in some states it may be harder to graduate from high school than to become a certified teacher. Something is wrong with this picture.

Last summer the U.S. Department of Education reported that approximately one-third of the nation's public school teachers of academic subjects in midd school and high school were teaching "out of field," which means that they ha earned neither an undergraduate major nor a minor in their main teaching fiel

Fully 39.5 percent of science teachers had not studied science as a major minor; 34 percent of mathematics teachers and 25 percent of English teachers were similarly teaching "out of field." The problem of unqualified teachers w particularly acute in schools where 40 percent or more of the students were f low-income homes; in these schools, nearly half the teaching staff was teaching "out of field."

Many states now routinely certify people who do not know what they are supposed to teach. No one should get a license to teach science, reading, mathematics or anything else unless he or she has demonstrated a knowledge of what students are expected to learn.

The Washington Post, February 25, 1998

A majority of the nation's teachers majored in education rather than an academic subject. This is troubling, even though most of those who majored in education are elementary teachers. There is a widely accepted notion that peo who teach little children don't need to know much other than pedagogical meth and child psychology; that is wrong. Teachers of little children need to be well-educated and should love learning as much as they love children. Yes, ev elementary school teachers should have an academic major.

The field of history has the largest percentage of unqualified teachers. T Department of Education found that 55 percent of history teachers are "out of field," and that 43 percent of high school students are studying history with teacher who did not earn either a major or minor in history. This may explain why nearly 60 percent of our 17-year-olds scored "below basic" (the lowest possible rating) on the most recent test of U.S. history administered by the federally funded National Assessment of Educational Progress. Only one out of every five teachers of social studies has either a major or minor in history. it any wonder that today's children have no idea when the Civil War occurred, what Reconstruction was, what happened during the progressive era, who FDR wa what the Brown decision decided, or what Stalin did? Many of their teachers don't know those things either.

There are many conditions over which school officials have no control, but they have complete control over who is allowed to teach. Why should anyone b certified to teach science or history who doesn't know what he or she is expected to teach the children?

Many state officials say that they have an abundance of people who want t teach and that this is actually an excellent time to raise standards. For career-changers with a wealth of experience in business or the military, however, obsolete certification requirements get in the way. Instead of requiring irrelevant education courses, states should examine prospective teachers for their knowledge of their academic field and then give them a ch to work in the schools as apprentice teachers.

As Congress ponders ways to improve the teaching profession, it should consider incentives for colleges of liberal arts to collaborate with schools education in preparing future teachers. Representatives from both parts of t same campus should sit down together, study state academic standards and fi out how to prepare teachers who know both their subject and how to teach it well. Teachers need a strong academic preparation as well as practical clas experience to qualify for one of the toughest jobs in America.

Every classroom should have a well-educated, knowledgeable teacher. We a far from that goal today. Congress can address this problem by focusing on quality, not quantity, of the nation's teaching corps.

The writer, a senior fellow at the Brookings Institution, was an assista secretary of education in the Bush administration.

LANGUAGE: ENGLISH

LOAD-DATE: February 25, 1998

PRESIDENT CLINTON CONVENES TOP LEADERS CHALLENGES NATION TO IMPROVE MATH AND SCIENCE EDUCATION

March 16th, 1998

President Clinton convened leaders from government, business, education, and the scientific community to discuss how the nation should respond to recent findings from the Third International Math and Science Study (TIMSS) showing that U.S. 12th graders lagged below the international average in science and math. This followed earlier findings showing U.S. 4th graders near the first in the world in science and above average in math, with U.S. 8th graders slipping to slightly above average in science and below average in math. The President called on the nation to move forward on his plan to improve American education and issued new challenges to boost student achievement in math and science. He also announced new on-line math and science help for parents, teachers, and students.

A CHALLENGE TO IMPROVE MATH AND SCIENCE EDUCATION. Improved math and science education is critical to prepare our students and nation for the 21st century. President Clinton challenged public officials, business leaders, universities, schools, teachers, parents, and students to take the steps necessary to boost student achievement in math and science.

Reducing out-of-field teaching. The President challenged states to reduce the percentage of math and science teachers without a major or minor in their subject area. The average K-8th grade math teacher takes only three undergraduate math courses. Twenty-eight percent of secondary math teachers lack a major or minor in their subject area, as do 18% of secondary science teachers and 55% of physics teachers.

Rigorous Tests for New Teachers. To help address this challenge, the President called on states to require all new teachers of math and science to pass challenging tests of math or science knowledge and teaching proficiency. With nearly half of our nation's teaching force to be replaced over the next several years in order to accommodate growing student enrollments and an aging teaching force, raising standards of teaching now can boost the quality of our schools for decades.

A Call to Action for Schools, Students, and Parents. The President also challenged schools to offer and students to take tough math and science courses in middle school and high school. Just a quarter of U.S. students take algebra before high school, and only 25% of U.S. high school students take physics. The President also called on parents to insist that states and school districts provide ways of showing how children are doing compared to national standards and international benchmarks. Today parents have no way of finding out how their children do compared to the international standards in TIMSS. The President called on the nation to take the steps necessary to boost student achievement in math and science and encouraged young people with proficiency in math and science to consider careers in teaching.

PRESIDENT CLINTON'S EDUCATION AGENDA: MAKING OUR ELEMENTARY AND SECONDARY SCHOOLS THE FINEST IN THE WORLD. The recent TIMSS findings demonstrate the importance of President Clinton's bold plan to improve American education and boost student achievement in math, science, and other academic subjects.

Voluntary National Standards and Tests in Math and Reading. In his 1997 State of the Union Address, President Clinton challenged every state to adopt high national standards and to test every 4th grader in reading and 8th grader in math to make sure these standards are met. Rigorous 8th grade math testing can help make sure that middle school students are prepared to succeed in tough math and science courses in high school. Voluntary national tests are being developed under the control of the bipartisan, independent National Assessment Governing Board.

Smaller Classes with Well-Prepared Teachers. President Clinton is proposing to help local schools provide small classes with well-prepared teachers in the early grades. The new initiative will help hire an additional 100,000 well-prepared teachers and reduce class size in grades 1-3 to a nationwide average of 18. The President is also proposing support for training teachers in math, science, and technology and for recruiting quality teachers into poor schools and high-need subjects like math and science.

Modern School Buildings to Improve Student Learning. For students to learn and to compete in the global economy, schools must be well-equipped and they must be able to accommodate smaller class sizes. That's why President Clinton is proposing federal tax credits to pay interest on nearly $22 billion in bonds to build and renovate public schools.

Education Opportunity Zones: Ending Social Promotion and Fixing Failing Schools. The President's budget contains support for urban and rural school districts undertaking tough reforms including ending social promotion and fixing failing schools. This initiative would help students meet promotion standards at selected grades, help turn around failing schools, and expand parental choice among public schools.

Technology for Our Schools and Rigorous Math and Science Courses for Our Students. The President's plan would ensure that all our children get access to the "information superhighway." His "High Hopes" plan would support partnerships to help low-income students get access to the rigorous math and science courses needed to prepare them for college. The President's budget also contains $60 million to improve math and science curriculum and teaching in middle schools.

NEW ON-LINE ASSISTANCE FOR PARENTS, STUDENTS, AND TEACHERS. President Clinton announced two new on-line resources developed by the U.S. Department of Education and other agencies.

"Federal Resources for Educational Excellence" (FREE) Web-site. A new website is available today to connect teachers, parents, and students to teaching and learning resources in math, science, and other subject areas from NASA, the Energy Department, the National Science Foundation, and other agencies. The address is www.ed.gov/free

The TIMSS On-Line Challenge. The U.S. Department of Education will launch this fall a website that puts TIMSS math and science problems on-line. This will enable parents to give a quiz to their children, learn what their children should know in math and science to be internationally competitive, and learn how their children are doing compared to students from other countries.

RECENT STUDY SHOWS NEED TO BOOST ACHIEVEMENT IN MATH AND SCIENCE TIMSS showed that U.S 12th graders scored among the lowest of 21 nations in general math and science. Performance of U.S. 12th graders in advanced math and physics courses also lagged behind other nations. The 12th grade findings completed a multi-year study showing U.S. 4th graders near the first in the world in science and above average in math, with U.S. 8th graders slightly above the international average in science and below the international average in math.

While other tests (including the National Assessment of Educational Progress) show that U.S. student achievement is improving, TIMSS makes clear that these improvements are not rapid enough to keep pace with other nations in an increasingly global economy.

PARTICIPANTS IN MEETING ON MATH AND SCIENCE EDUCATION

Secretary Richard Riley
Secretary Federico Pena
Governor Parris Glendening, Maryland
Governor Cecil Underwood, West Virginia
Mayor Richard Daley, Chicago, IL
Mayor Richard Riordan, Los Angeles, CA
Mayor Lee Clancey, Cedar Rapids, IA
William Schmidt, National Coordinator for TIMSS, Professor at Michigan State University
Rudy Crew, Chancellor of New York City Schools
Diane Ravitch, Former Assistant Secretary of Education in the Bush Administration. Currently, a Senior Fellow at Brookings and Research Professor at New York University.
Bruce Alberts, President of the National Academy of Sciences
Neil Lane, President of the National Science Foundation
Bill Nye, Host of Weekly Television Show,"Bill Nye The Science Guy"
Alan Wurtzel, Vice Chairman of the Board for Circuit City, and Chair of the National Alliance of Business Task Force on Education Standards
Wilmer Cody, Chair of the Chief State School Officers and Commissioner of Education in Kentucky
Robert Moses, Director of the Algebra Project, which helps disadvantaged students prepare for rigorous math classes
Bob Chase, NEA President
Sandy Feldman, AFT President
Nancy Grasmick, Superintendent of Schools, Maryland
Migues Nevarez, President of University of Texas Pan American
Walter Secada, Professor of Math and Science Education at the University of Wisconsin, and Director of the Hispanic Dropout Project
Cindy Mayorga, Springbrook High School Student
Cyrus Ishikawa, Springbrook High School Math and Physics Teacher
Congresman Wynn
Senator Sarbanes

Educ—
TIMSS

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PURSUING EXCELLENCE:

A STUDY OF U.S. EIGHTH-GRADE MATHEMATICS AND SCIENCE TEACHING, LEARNING, CURRICULUM, AND ACHIEVEMENT IN INTERNATIONAL CONTEXT

Initial Findings from the

Third International Mathematics and Science Study

National Center for Education Statistics

U.S. Department of Education

November 8, 1996 Draft

TABLE OF CONTENTS

EXECUTIVE SUMMARY

PREFACE
- Overview
- Study design
- The TIMSS research team
- Organization of this report

CHAPTER 1: ACHIEVEMENT
- How well do U.S. students do?
- Some special notes on the test scores.
- Which countries outperform the U.S. in both subjects?
- Which countries does the U.S. outperform in both subjects?
- How do we compare to our major economic partners?
- How far behind the top country are we?
- How do our best students compare with others' best?
- How does the U.S. gender gap compare to other countries'?
- How do we score in the different content areas of math and science?
- What did prior studies show about how U.S. states compare to other countries?
- Has U.S. international standing improved over time?

CHAPTER 2: CURRICULUM
- Who sets curriculum standards?
- Is curriculum in the U.S. as focused as in other countries?
- Is curriculum in the U.S. as advanced as in other countries?
- How much time is spent in class?

CHAPTER 3: TEACHING
- How do U.S. mathematics teachers structure and deliver their lessons?
- Is the mathematical content of U.S. lessons as rich as in Germany and Japan?
- To what extent are the recommendations of the mathematics reform movement being implemented?
- What do initial findings show about science teaching?

CHAPTER 4: TEACHERS' LIVES
- Who teaches math and science?
- How do teachers spend their time?
- How do teachers learn to teach?
- What challenges do teachers face?

CHAPTER 5: STUDENTS' LIVES
- What does the system require of students?
- How do students spend their time during school?

How much study do students do after school?
What do students think about math and science?
What do students do after school besides study?

CONCLUSIONS
Where do we stand?
What have we learned about mathematics?
What have we learned about science?
What have we learned about education as a whole?
Questions for future study
TIMSS' long-term utility to the nation.

APPENDIX 1: Additional TIMSS Reports
APPENDIX 2: Advisors to the U.S. TIMSS Study
APPENDIX 3: National Average Scores and Standard Errors
APPENDIX 4: Summary of National Deviations from International Study Guidelines

FIGURE 1: Nations' Average Mathematics Performance Compared to the U.S.
FIGURE 2: Nations' Average Science Performance Compared to the U.S.
FIGURE 3: Average Achievement of Nations Meeting, and Not Meeting International Guidelines
FIGURE 4: Percent of Students from Selected Nations Chosen in a Talent Search for the Top 10 Percent of Eighth Graders in the 41 TIMSS Countries
FIGURE 5: National Averages in Mathematics Content Areas
FIGURE 6: National Averages in Science Content Areas
FIGURE 7: Number of TIMSS Countries Determining Curriculum at Various Levels
FIGURE 8: Hours of Mathematics and Science Instructional Time Per Year for Eighth Graders
FIGURE 9: Comparison of the Steps Typical of Eighth-Grade Mathematics Lessons in Japan, the U.S., and Germany.
FIGURE 10: Average Percentage of Topics in Eighth-Grade Mathematics Lessons that are Stated or Developed
FIGURE 11: Expert Judgments of the Quality of the Mathematical Content of Eighth-Grade Lessons
FIGURE 12: Percentage of Mathematics Teachers of TIMSS Students Reporting that Various Circumstances Limit Their Teaching "Quite a Lot" or "A Great Deal."
FIGURE 13: Discipline Problems Eighth-Grade Principals Deal With on a Daily Basis
FIGURE 14: Percent of Mathematics and Science Teachers Who Assign Homework 3-5 Times Per Week
FIGURE 15: Percentage of Eighth-Graders Spending 3 or More Hours in Various After-School Activities on a Normal Day.

EXECUTIVE SUMMARY

PREFACE

The Third International Mathematics and Science Study (TIMSS) is the largest, most comprehensive, and most rigorous international comparison of education ever undertaken. During the 1995 school year, the study tested the math and science knowledge of a half-million students from 41 nations at five different grade levels. In addition to tests and questionnaires, it included a curriculum analysis, videotaped observations of mathematics classrooms, and case studies of policy issues.

- TIMSS' rich information allows us not only to compare achievement, but also provides insights into how life in U.S. schools differs from that in other nations.

- This report on eighth-grade students is one of a series of reports that will also present findings on student achievement at fourth grade, at the end of high school, as well as on various other topics over the coming year.

ACHIEVEMENT

One of our national goals is to be "first in the world in mathematics and science achievement by the year 2000," as President Bush and 50 governors declared in 1989. Although we are far from this mark, we are on a par with other major industrialized nations like Canada, England, and Germany.

- In mathematics, U.S. eighth graders score below the international average of 41 TIMSS countries. Our students' scores are not significantly different from those of England and Germany.

- In science, U.S. eighth graders score above the international average of 41 TIMSS countries. Our students' scores are not significantly different from those of Canada, England, and Germany.

- In mathematics, our eighth-grade students' international standing is stronger in Algebra and Fractions than in Geometry and Measurement.

- In science, our eighth graders' international standing is stronger in Earth Science, Life Science, and Environmental Issues than in Chemistry and Physics.

- If an international talent search were to select the top 10 percent of all students in the 41 TIMSS countries, in mathematics 5 percent of U.S. students would be included. In science 13 percent would be included.

CURRICULUM

U.S. policy makers are concerned about whether expectations for our students are high enough, and in particular whether they are as challenging as those of our foreign economic partners. In all countries, the relationship between standards, teaching, and learning is complex. This is even more true in the U.S., which is atypical among TIMSS countries in its lack of a nationally defined curriculum.

- The content taught in U.S. eighth-grade mathematics classrooms is at a seventh-grade level in comparison to other countries.

- Topic coverage in U.S. eighth-grade mathematics classes is not as focused as in Germany and Japan.

- In science, the degree of topic focus in the U.S. eighth-grade curriculum may be similar to that of other countries.

- U.S. eighth graders spend more hours per year in math and science classes than German and Japanese students.

TEACHING

In recent years, concern about the quality of instruction in U.S. classrooms has led mathematics professional organizations to issue calls for reform. However, TIMSS data cannot tell us about the success of these reform efforts for several reasons, including the fact that this assessment occurred too soon after the beginning of the movement for states and districts to have designed their own programs, retrained teachers, and nurtured a generation of students according to the new approach. Also, we do not have comparable earlier baseline information against which to compare findings from TIMSS. However, TIMSS includes the first large-scale observational study of U.S. teaching ever undertaken, and this can form a baseline against which future progress may be judged.

- U.S. mathematics classes require students to engage in less high-level mathematical 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.

- Japanese teachers widely practice what the U.S. mathematics reform recommends, while U.S. teachers do so infrequently.

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

- According to teacher reports, U.S. eighth-grade science instruction may include more high-level thought than in Germany and Japan.

TEACHERS' LIVES

The training that teachers receive before they enter the profession and the regular opportunities that they have for on-the-job learning and improvement of their teaching affect the quality of the teaching force. The collegial support that teachers receive and the characteristics of their daily lives also affect the type of teaching they provide.

- Unlike new U.S. teachers, new Japanese and German teachers undergo long-term structured apprenticeships in their profession.

- U.S. teachers have more college education than their colleagues in all but a few TIMSS countries.

- Japanese teachers have more opportunities to discuss teaching-related issues than do U.S. teachers.

- Student diversity and poor discipline are challenges not only for U.S. teachers, but for German teachers as well.

STUDENTS' LIVES

The manner in which societies structure the schooling process gives rise to different opportunities and expectations for young people. The motivators, supports, and obstacles to study in each country are outgrowths of the choices provided by society and schools.

- Eighth grade students of different abilities are typically divided into different classrooms in the U.S., and into different schools in Germany. In Japan, no ability grouping is practiced at this grade level.

- In mathematics, U.S. students in higher ability-level classes study different material than students in lower-level classes. In Germany and Japan, all students study basically the same material, although in Germany the depth and rigor of study depends on whether the school is for students of higher or lower ability levels.

- Japanese eighth-graders are preparing for a high-stakes examination to enter high school at the end of ninth grade.

- 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.

- Heavy TV watching is as common among U.S. eighth graders as it is among their Japanese counterparts.

CONCLUSIONS

This report presents initial findings from TIMSS for eighth grade mathematics and science. A fuller understanding of our nation's educational health must await data from the fourth and twelfth grade levels. The search for factors associated with student performance is complicated because student achievement after eight years of schooling is the product of many different factors. Furthermore, the U.S. education system is large and decentralized with many interrelated parts. No single factor in isolation from others should be regarded as the answer to improving the performance of U.S. eighth-grade students. With these cautions in mind, this report offers the following insights into factors that may be associated with our students' performance:

- The content of U.S. eighth-grade mathematics classes is not as challenging as that of other countries, and topic coverage is not as focused.

- Topic coverage is not as focused in U.S. eighth grade mathematics classes as in the classrooms of other countries.

- Most U.S. mathematics teachers report familiarity with reform recommendations, although only a few apply the key points in their classrooms.

- According to teacher reports, U.S. science instruction includes more high-level thought than in Germany and Japan.

- Evidence suggests that U.S. teachers do not receive as much practical training and daily support as their German and Japanese colleagues.

TIMSS is not an answer book, but a mirror through which we can see our own education system in international perspective. Careful study of our nation's reflection in the mirror of international comparisons will assist educators, business leaders, teachers, and parents as they guide our nation in the pursuit of excellence.

CONCLUSIONS

This report has presented highlights from initial analyses of U.S. eighth graders in international perspective. These findings lightly sketch only a corner of the entire picture of U.S. performance in mathematics and science which will be painted over the next years as further analysis of the eighth grade data is carried out and findings from grades four and twelve are added.

This section looks across the findings presented in the previous pages for insights into the key questions with which the study started: How do our eighth graders compare to their international counterparts? What have we learned about mathematics achievement and the factors that may be associated with it? What have we learned about science? What have we learned about how our education system as a whole compares to that of other countries?

Looking for insights into factors associated with student performance is complicated because achievement after eight years of schooling and thirteen years of life is the product of many different influences. Furthermore, education in our country is a vast system with many interrelated parts. **No single factor can be properly considered in isolation from others. Realizing that there are no single answers to complex questions, let us review the data.**

WHERE DO WE STAND?

The U.S. is far from being among the top nations of the world in mathematics and science. Singapore, Korea, Japan, the Czech Republic, and Hungary outperform us in both subjects. Particularly in mathematics, our students lag far behind top-ranking countries. **Compared to our goal of excellence among nations, we are not where we aim to be.**

However, we are on a par with many of our international trading partners. Our students stand not far from the international average: somewhat below in mathematics, and somewhat above in science. Our math scores are not significantly different than those of Germany and England. Our science scores are not significantly different than those of Germany, England, Canada, and Russia. We rank near the middle of the 41 TIMSS countries, among other nations to whom we frequently compare ourselves.

WHAT HAVE WE LEARNED ABOUT MATHEMATICS?

Our eighth graders score below the international average in mathematics. Although international comparisons over time are difficult, there does not appear to have been much improvement during the past three decades in U.S. students' international standing in this subject. The following factors may be associated with this performance:

- ***The content of U.S. eighth-grade mathematics classes is not as challenging as that of other countries.***

  U.S. eighth-grade curriculum and instruction both appear to be less challenging than those in other countries. Concerning curriculum, topics covered in U.S. mathematics classrooms were at a seventh-grade level in comparison to other countries. Virtually all German and Japanese students study algebra and geometry in the eighth grade, while in the U.S., only students in higher-level classes receive significant exposure to algebra, and few students study geometry.

  Concerning instruction, the content of U.S. classes requires less high-level thought than classes in Germany and Japan. The mathematical reasoning used in lessons was judged to be of low quality in a majority of U.S. classrooms, while this was less frequently the case in the other two countries.

- ***Topic coverage is not as focused in U.S. eighth grade mathematics classes as in the classrooms of other countries.***

  In the U.S., curriculum is determined at the state and local level, which is atypical among TIMSS countries, most of whom determine curriculum nationally. In all grades 1-8, the U.S. mathematics curriculum recommends coverage of more topics than the international average. Mathematics lessons also include a greater number of topics and activities than in Germany and Japan.

- ***Most U.S. eighth-grade math teachers report familiarity with reform recommendations, although only a few apply the key points in their classrooms.***

  Ninety-five percent of U.S. eighth-grade mathematics teachers say that they are aware of current ideas about teaching and learning mathematics. Most believe that the lessons they teach exemplify elements of the recommendations. However, the way in which U.S. teachers understand and implement these recommendations suggests that they are focusing on isolated techniques rather than the central message that teaching and learning should involve high-level mathematical thought. Our mathematics teachers' typical goal is to teach students how to do something, rather than how to think about and understand mathematical concepts. In a variety of respects, Japanese mathematics teaching more closely resembles the recommendations of the U.S. reform movement.

WHAT HAVE WE LEARNED ABOUT SCIENCE?

U.S. eighth graders score above the international average in science. In the three previous international science assessments, the U.S. scored below the international average. Because comparisons of different international assessments over time are difficult, caution

should be exercised in assuming that there has been significant improvement in our international standing in science, but it may be a possibility.

This initial report contains less information about science than about mathematics because the questionnaire data has not yet been fully analyzed, and the videotape study of classroom instruction was conducted only in mathematics. Furthermore, because we are unable to use multiple research methods to verify the science findings from different perspectives, our findings are more tentative than for mathematics. Looking across the findings with this caution in mind, the following factor may be associated with U.S. science performance:

- ***According to teacher report, U.S. eighth-grade science instruction includes more high-level thought than in Germany and Japan.***

  Science teachers of the TIMSS students report on questionnaires that they ask students to explain their reasoning and to solve problems with no obvious solution more frequently than do teachers in Germany or Japan. Fuller description of eighth-grade science teachers' instructional practices must await further questionnaire analysis.

WHAT HAVE WE LEARNED ABOUT U.S. EDUCATION AS A WHOLE?

TIMSS provides several insights about U.S. eighth-grade teachers and students, which are true of both mathematics and science education.

- ***Evidence suggests that U.S. teachers do not receive as much practical training and daily support as their German and Japanese colleagues.***

  In contrast to new German and Japanese teachers, new U.S. teachers do not receive a long-term structured apprenticeship in their profession. Once on the job, they have fewer formal and informal opportunities to discuss and share teaching-related issues and questions. Schools are managed in such a way that lessons are frequently interrupted by loudspeaker announcements or visitors at the door.

- ***Our eighth graders spend at least as much time studying mathematics and science as students in Germany and Japan.***

  During school, our eighth graders spend more hours in mathematics and science classes per year than students in Germany and Japan. U.S. teachers assign more homework, and spend more class time discussing it than teachers in those countries. Outside of school, our students report doing about as much math and science-related homework and other study as German and Japanese students,

although most Japanese eighth graders also attend after-school classes in mathematics for an hour or two per week in preparation for the entrance exams to high school.

QUESTIONS FOR FURTHER STUDY

The initial findings described in this report raise many important questions for further study. Some of these may be answered through continued analysis of the eighth-grade data. Others must await the design of future international studies. For this reason, TIMSS is an important national resource for secondary analysis and further research. Some examples are:

- ***Why is our international standing lower in mathematics than in science?***

  Deeper analysis of the TIMSS data will help us to compare the curriculum and instructional practices used in mathematics with those in science, to better understand the similarities and differences.

- ***How is student achievement related to curriculum coverage?***

  Comparison of the curriculum analysis with achievement scores in the various content areas can illuminate the degree to which our students' performance in algebra, earth science, and other content areas is related to curricular emphasis in these areas.

- ***Does mathematics teaching in high performing countries resemble the reform movement's recommendations?***

  The videotape study found that in many ways, Japanese mathematics teaching resembles the recommendations of the U.S. reform movement more closely than does U.S. and German teaching. Is this an important factor in understanding why Japan also scores among the top nations of the world in mathematics? Undertaking similar videotape observational studies of other high-performing nations and further analysis of the TIMSS teacher questionnaire data could provide insight into this question.

TIMSS' LONG TERM UTILITY TO THE NATION

TIMSS is not an answer book, but a mirror through which we can see our own education system in international perspective. It helps us view with new eyes those aspects of our system which we take for granted. Its findings make us think more deeply

about the cultural assumptions and unconscious choices which form the underpinnings of our society's approach to schooling. We come to understand our own system better by comparing it to others. Careful study of our country's reflection in the mirror of international comparisons can provide information to assist educators, business leaders, teachers, and parents as they guide our nation in the pursuit of excellence.