Office of Shared Accountability
MONTGOMERY COUNTY PUBLIC SCHOOLS
Rockville, Maryland

INTERNATIONAL PERFORMANCE STANDARDS IN MONTGOMERY COUNTY PUBLIC SCHOOLS

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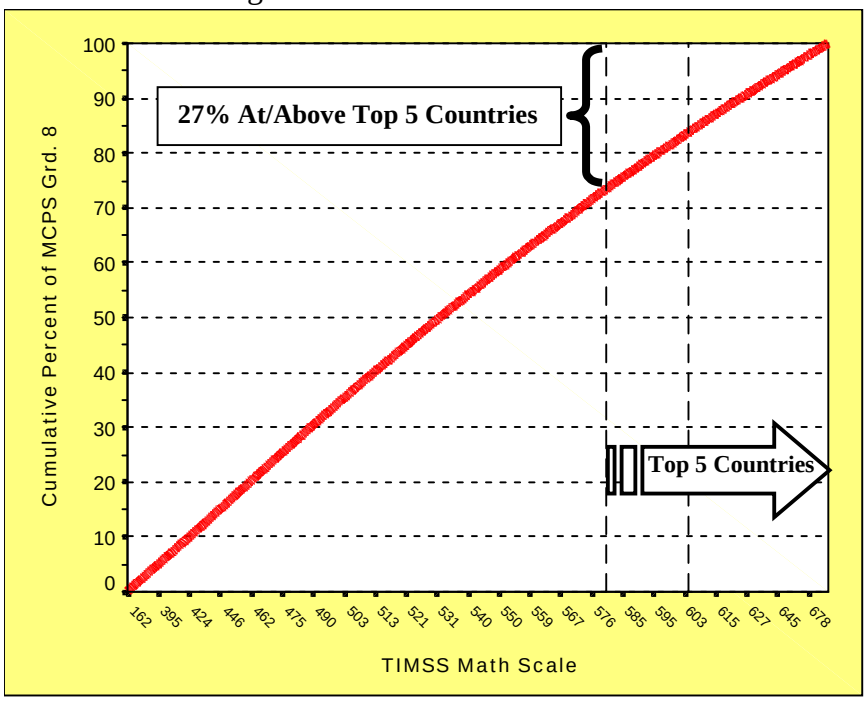
INTERNATIONAL PERFORMANCE STANDARDS IN MONTGOMERY COUNTY PUBLIC SCHOOLS

A large percentage of Montgomery County Public Schools (MCPS) eighth graders attained world-class standing on mathematics and science tests administered in 1999 to students in 38 countries, 13 states and 14 school districts. Forty percent of the eighth grade students in science and 27 percent of the students in mathematics scored in the range of the top five nations. The Third International Mathematics and Science Study–Repeat (TIMSS-R) was coordinated by the International Study Center at Boston College under the direction of the International Association for the Evaluation of Educational Achievement (IEA). The IEA conducted TIMSS in 1995 for students in Grades 4, 8 and 12 in more than 40 countries. The 1999 TIMSS-R study was limited to Grade 8 students in the participating countries.

World-class performance among many MCPS students

Mathematics. In mathematics, the top 5 countries were all Asian nations[1] whose average scores ranged from 579 to 604. In MCPS the average score was 537, and 27 percent of the sample of eighth graders scored at or above the range of top five countries' averages (see Figure 1).

Figure 1
Distribution of TIMSS-R Mathematics Scores for
Eighth Grade Students in MCPS

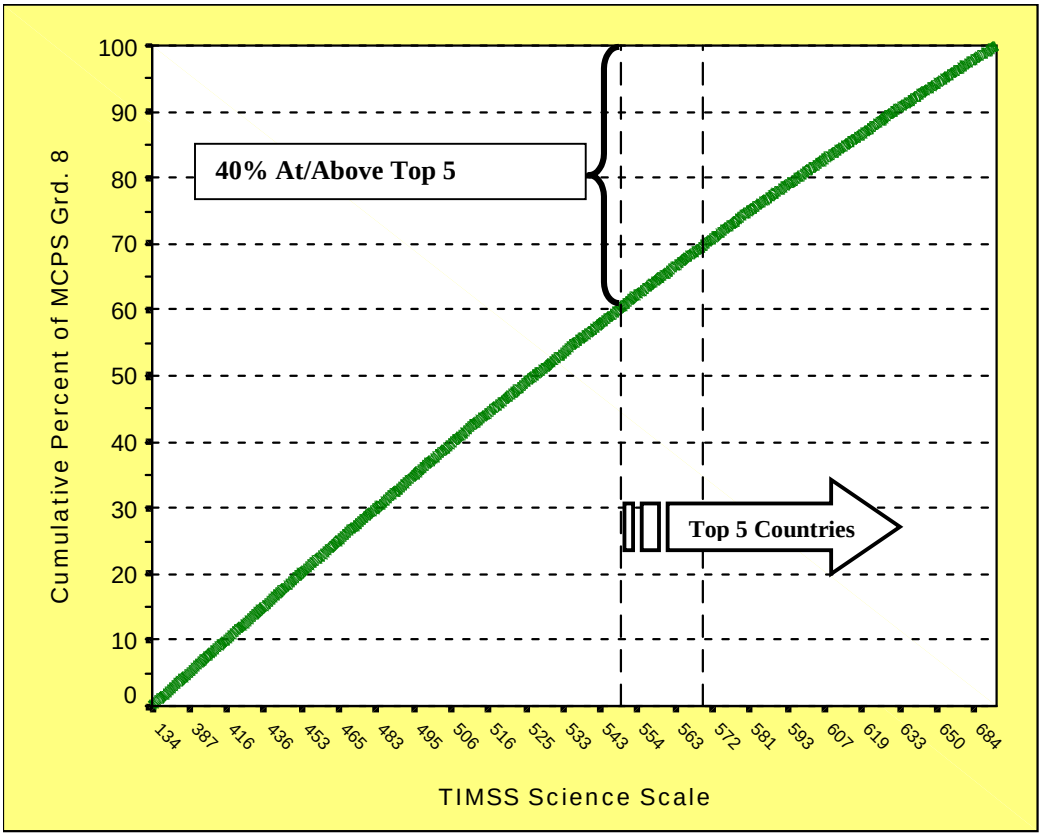


[1] The top 5 countries in mathematics performance were: Singapore, 604; Republic of Korea 587; Chinese Taipei, 585; Hong Kong, 582; and Japan, 579. The international average was 487; the US average 502; and the MCPS average 537.

Rankings of the average scores among countries, states and school districts do not convey as much information as does the percentage of students that attain scores above a rigorous criterion. This is because many of the nations' average scores are packed into a narrow range. For example, in mathematics MCPS ranked just below the 7th place country internationally, and outscored all but 2 of the 27 school districts and states in the sample.[2] However, when adjustments are made for the statistical error bands that inevitably surround average scores, the MCPS average score was statistically equivalent to 8 countries, significantly higher than the average scores for 23 countries or districts (including the Maryland state sample and the US sample), and lower than the average scores for 7 countries by a statistically significant margin.

Science. In science, the top 5 countries[3] produced average scores ranging from 549 to 569. The MCPS average science score was 531, and 40 percent of the MCPS eighth graders attained science scores at or above the averages of the top five countries (see Figure 2).

Figure 2.
Distribution of TIMSS-R Science Scores for
Eighth Grade Students in MCPS.



[2] See Addendum for rankings among countries, and participating states and school districts.

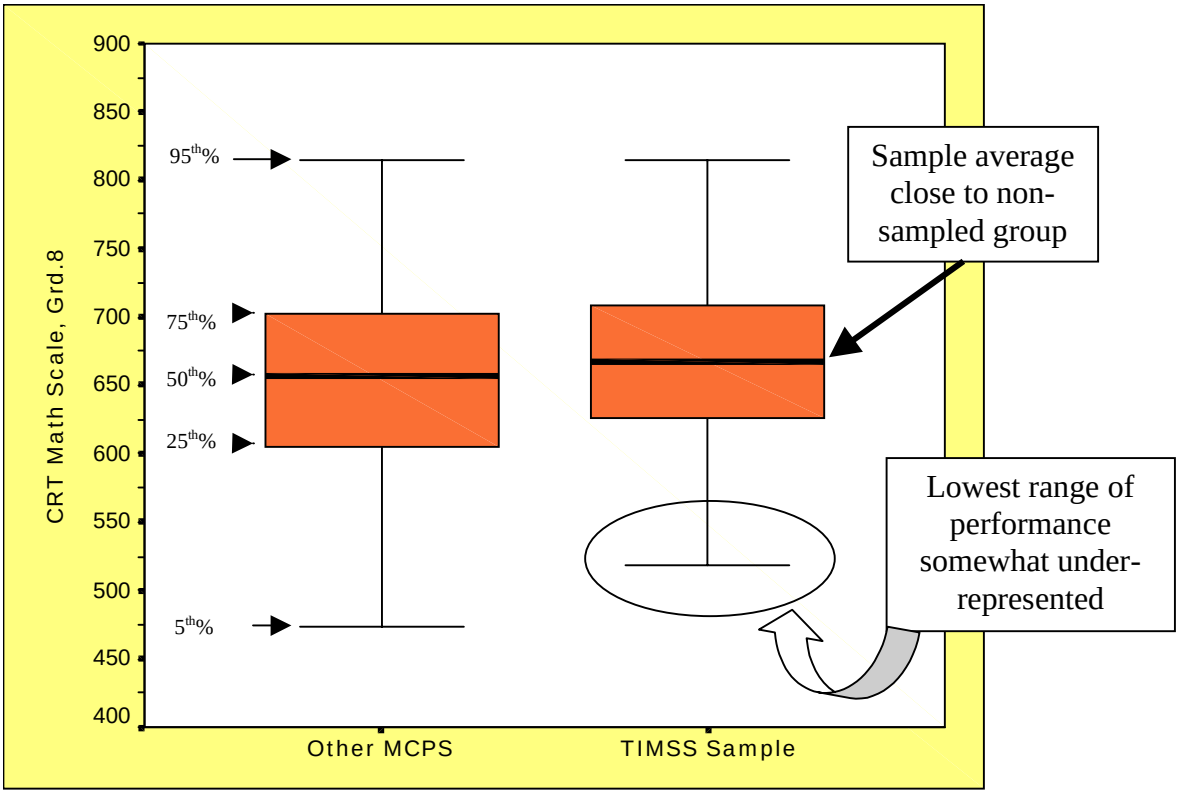
[3] The top 5 countries in science performance were: Chinese Taipei, 569; Singapore, 568; Hungary, 552; Japan, 550; and Republic of Korea, 549. The international average was 488; US average 515; and the MCPS average 531.

The rankings in science showed that MCPS stood just below the 14th place country. However, because the national averages were so closely grouped, the MCPS average in science was below only 5 countries by a statistically significant margin, was statistically equivalent to 13 countries (including the Maryland state sample and the US sample), and was higher than 20 countries by a statistically significant margin. In both mathematics and science, the range of student variations within MCPS and within other groups spanned a very wide range across the international ranking of average scores.

Representative sample

The sample of 1,144 eighth grade students tested for TIMSS-R in MCPS can be used to produce an accurate representation of the entire 8,964 students enrolled in eighth grade during the 1998-99 school year. Students tested for TIMSS-R were randomly sampled by Westat, Inc., the sampling contractor for TIMSS-R. The result provided students from 25 of the school district's 32 middle schools. Students taking algebra in eighth grade

Figure 3.
TIMSS-R Sample Compared to Non-Sample on
Local Mathematics Test Scores.



were slightly over-represented, and students taking regular math were slightly under-represented. However, the results described above were weighted to produce system-wide estimates that accurately represented the entire eighth grade class in MCPS.[4]

[4] When TIMSS-R records were matched with MCPS student test records, we found that the TIMSS-R sample slightly under-represented students who were enrolled in regular mathematics classes and slightly

Profiles by topic areas

Mathematics. On the mathematics test, students in MCPS scored higher on the topics of data representation and analysis, algebra, and number sense and fractions than on the topics of measurement and geometry. A similar profile of mathematics topics was also reported for the Maryland state sample and for the US sample. Algebra and number sense/fractions were also reported by MCPS teachers to be the topics emphasized most in their instruction.

Science. On the science test, students in MCPS scored higher on the topics of scientific inquiry and life sciences than on the topics of earth or environmental sciences, chemistry, and physics. Those two topics of relative strength were also reported in the Maryland state sample and in US sample for the science test.

In MCPS, the mathematics strength in data analysis and algebra combined with the science strength in scientific inquiry and the nature of science suggest a curricular strength in MCPS for understanding and solving problems. This aspect of academic performance is consistent with the state goals for education expressed in the Maryland State Performance Assessment Program.

Mathematics course levels differ greatly in performance

The placement of students into different levels of mathematics courses greatly determines the opportunities to learn various levels of mathematics topics. And, those placements are in turn related to the prior preparation levels of students. The curricular structure of mathematics instruction in the US, as recorded in the TIMSS study of 1995, has been criticized as too repetitive and covering too many topics in too little detail.[5] A similar criticism was leveled at the US mathematics curriculum after the Second International Mathematics and Science Study of 1982.[6] For example, US textbooks for eighth grade mathematics typically cover many more topics and in less depth than the topic coverage

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over-represented students enrolled in algebra classes. On the locally administered mathematics test, the TIMSS-R sample scored 10 points higher (about one-sixth of a standard deviation unit) than the non-sampled group. Consequently, the data described above were weighted so that the proportion of sampled students enrolled in each level of mathematics course matched the system-wide proportion of students in those mathematics course levels. This weighting procedure brought the TIMSS-R sample average on the local mathematics test to within 2 points of the non-sampled group average. This weighting procedure also produced an estimate for TIMSS-R mathematics average score of 532, or 5 points lower than the unweighted MCPS average reported by TIMSS-R. The weighted TIMSS science score of 528 was just 3 points lower than the unweighted score of 531 reported by TIMSS-R.

[5] Valverde, Gilbert A. and Schmidt, William H. (2000) "Greater Expectations: Learning from other nations in the quest for world-class standards in US school mathematics and science." (in press).

[6] McKnight, Curtis C., Crosswhite, F. J., Dossey, John A., Kifer, Edward, Swafford, Jane O., Travers, Kenneth J. and Cooney, Thomas J. (1987) *The Underachieving Curriculum: Assessing US school mathematics from an international perspective*. Stipes Publishing:Champaign, IL.

in textbooks used in nations scoring high on the TIMSS mathematics scale. Also, topics in the US textbooks are repeated more from one year to the next, and fewer new topics are introduced each year than is true in the top-scoring countries. The net result is that students are challenged less in the US as they progress through secondary school than is true for students in high-scoring nations.

In MCPS the attempt has been made over the past 10 years to accelerate the presentation of mathematics content so that more students attain algebra by the end of eighth grade. The result has been that the percentage of students passing algebra or higher-level courses by the end of eighth grade rose from 27 percent in 1990-1991 to 36 percent in 1998-1999 when the TIMSS-R tests were administered. Results from the TIMSS-R analysis show that the students taking algebra in eighth grade attained an average mathematics score of 588. A score that high would place the MCPS algebra students in between the averages of the first place (Singapore) and second place (Korea) countries of the international samples. The 3 percent of eighth grade students studying geometry in MCPS attained an average score of 658 that would place them near the 75th percentile of the top-scoring country. MCPS eighth grade students in the regular mathematics course averaged 494, just below the US average of 502.

In the 1999-2000 school year the percentage of eighth grade students attaining algebra or higher in MCPS jumped to 41 percent. Therefore, an even large proportion of eighth grade students is likely performing at levels near to the highest-scoring countries in the world than was true in the TIMSS-R study. At the same time, a similar proportion of the eighth grade students is performing at much lower levels. The challenge remains to accelerate the curriculum for all students. As a result of a recent curriculum review in MCPS, much of the content in the middle school mathematics curriculum is being realigned into earlier grade levels in order to broaden the acceleration of the middle school mathematics program.

Equity in TIMSS-R performance

The racial/ethnic group divide that separates white and Asian students' school performance from that of African American and Hispanic students was apparent in the TIMSS-R results for MCPS, Maryland and the US samples. While all four racial/ethnic groups scored higher in MCPS than in the state or national samples, the magnitude of the African American-white difference was virtually the same in all three samples (between -81 and -83 points.) Asian and white students attained the same average score in MCPS (564); however, the Hispanic-white difference in MCPS (-84 points) was somewhat larger than the Hispanic-white difference in the Maryland sample (-34 points) and in the US sample (-68 points).

A similar pattern of racial/ethnic differences was found in the TIMSS-R science scores, with the exception that Asian students in MCPS scored 30 points lower than the white sample.

The challenges for teachers and staff in educating Hispanic and African American students to rigorous standards are quite real. For example, among eighth grade students in the current year, almost one in three Hispanic and African American students have not had the benefit of an elementary school education in MCPS. That figure for white students is one in six. Also, two-thirds to three-fourths of the eighth grade Hispanic and African American students have experienced poverty, as indicated by their previous participation in the free and reduced-price meals service (FARMS). That figure for white students is one out of eight.

The challenge of educating children affected by poverty was evident across the group of 27 states and districts reported in TIMSS-R. Higher levels of FARMS were associated with lower levels of performance on the TIMSS-R mathematics and science tests. For example, the correlation between the state or district's percentage of FARMS participation and the group's TIMSS-R mathematics score was -.80.

In the MCPS sample, with a reported a FARMS participation rate of 25 percent, the average mathematics score of 537 was considerably higher than the average of 513 among all 9 states or districts in the FARMS range similar to MCPS (20 to 30 percent). Much of this relative benefit may have been due to the students studying higher-level mathematics. More detailed analysis showed that the regular mathematics class students in MCPS, whose FARMS participation rate was similar to that reported for the US (39 percent) also attained an average TIMSS-R mathematics score (494) close to the US average (502). These findings reiterate the need to support the achievement of low-performing students.

Consistent correlates of student performance

A review of the TIMSS-R data reveals several conditions that tend to be consistently related to levels of student performance. Some of these conditions operate at the national or district level, some within the classroom, and some from the students' background.

Curriculum. Valverde and Schmidt identify the curriculum conveyed in textbooks across many countries as a primary impetus toward educational achievement. Their characterization of the US mathematics curriculum as "a mile wide and an inch deep" parallels the description of the "underachieving curriculum" offered 10 years earlier by McKnight, et al. in their study of the Second International Mathematics Study. In the 1995 TIMSS, US fourth grade students attained higher international standing than did US eighth grade students, and the US students finishing high school attained even lower international standing. Those researchers conclude that the US curriculum does not challenge students with sufficient rigor at a sufficient pace. Where students are offered a challenging curriculum, such as the eighth grade algebra students in MCPS or the students in the Naperville, IL school district or the First in the World Consortium, the results are on par with the top students in the world.

Low classroom disruption. Across the samples of countries, states and nations, teachers that reported infrequent interruptions from outside the classroom had students with higher

achievement scores than did teachers that reported more frequent outside interruptions. This finding may signal the importance of orderly school environments in supporting student achievement. Such a factor is often cited in the "effective schools" research literature.

School and class attendance. Within jurisdictions reported in TIMSS-R, teachers that reported higher school and class attendance by students almost always had students that scored higher than did the students of teachers reporting lower attendance. Among the "high-attendance" or the "medium attendance" groups, countries, states and districts varied considerably in the achievement levels of their students because of the many factors influencing test scores. Thus, high attendance alone is not sufficient to produce world-class performance among students. However, with whatever other resources and supports the jurisdictions offered, students with good attendance generally performed better than those with poor attendance.

Home educational resources. The TIMSS-R researchers formulated in index representing a combination of books in the home, study supports for students at home, and parents' education levels. Within each of 38 samples in the TIMSS-R, the students with high home educational resources outperformed those with medium home educational resources, and they in turn scored higher than those with low home educational resources. In some jurisdictions the student performance gaps between these groups were large, and in other samples the gaps between these groups were small. In some high-scoring countries, the low home educational resources group outscored the high home educational resources from other countries. However, within each country, state and district, the availability of resources for educational supports in the home provided an advantage to students functioning within their school systems. The pervasiveness of this factor suggests that all districts, states and nations share the challenge to delivering more rigorous curriculum and instruction to all students.

No single answer accounts for educational performance

The zeal of educational reformers often leads them to fasten upon a single, favored solution to improve schools. However, other findings from the vast array of information in the TIMSS-R study belie the "silver bullet" approach to educational reform. Researchers examining the 1995 TIMSS data and the 1999 TIMSS-R results[7] reached many of the same conclusions that researchers examining the Second International Mathematics Study data labeled "deceptive explanations."[8] As the staples of educational research are examined one by one from the international perspective, few of them reveal consistent relationships to student performance.

Instructional time per week. For example, three of the top 5 countries spend less time per week on mathematics instruction than does the average US classroom. Within country, state or district, the students that have more hours of instruction per week often

[7] Valverde and Schmidt, op.cit.
[8] McKnight, et al., op. cit.

show lower average mathematics scores than do the students in those same groups that receive less instruction per week. Perhaps districts allocate more instruction to students who need it most.

Class size. The TIMSS-R data cannot be used to assess the importance of class size because so many of the mathematics classes appear in the 21 to 35 student range, and those that appear in the range less than 20 often show lower average achievement scores. Again, the data likely reflect, in part, national or school district programs that provide smaller classes for students more in need.

Homework. An examination of the number of hours of homework that students study per day proves inconclusive. In 32 of the 39 comparisons across countries, states and districts, students who report studying less than one hour of mathematics per day have higher average scores than those who report studying more than one hour per day. On the other hand, students who report spending no time on mathematics homework have lower scores, on average, than do other students in their districts.

Emphasis on mathematics reasoning and problem-solving. A review of data on teacher's emphasis on mathematics reasoning and problem-solving likewise proves inconclusive. In 21 country, state or district samples the students with teachers who reported high emphasis on mathematics reasoning and problem-solving averaged higher achievement scores than did other students in their samples. However, in 10 other samples the students with teachers reporting medium emphasis scored highest in their sample. Also, although high-scoring Japan reported the most emphasis on mathematics reasoning and problem-solving, the higher-scoring Singapore and Hong Kong samples reported among the lowest emphasis on mathematics reasoning and problem-solving. One of the lowest-scoring school districts in the US group also reported very high emphasis on mathematics reasoning and problem-solving.

Teachers with mathematics major. Countries, states and districts with teachers who had a mathematics major from college tended to score higher than samples with lower percentages of those teachers, but they scored only moderately higher. There were notable exceptions. For example, MCPS reported relatively fewer teachers with mathematics majors (27 percent compared to the US average of 41 percent) and yet showed the third-highest average mathematics performance among states and districts.

Such factors as these may play an important role in supporting student achievement. However, they are wrapped within complex organizations of other factors also at play within and across school districts, states and nations. Therefore, such "culture-bound" factors will not likely lead to success if they are simply clipped out of their local contexts and emulated elsewhere without the other important conditions that support their efficacy.

ADDENDUM

The following materials were provided by the International Study Center of Boston College. The ISC is responsible for analysis and reporting of TIMSS-R.

TIMSS 1999 Benchmarking Study: *At a Glance*

What:

The TIMSS 1999 Benchmarking Study enabled states and school districts within the United States to participate in TIMSS 1999, also known as TIMSS-Repeat or TIMSS-R. TIMSS 1999 enabled countries to evaluate their mathematics and science programs in an international context. The results from TIMSS 1999 which involved 38 countries including the United States were released four months ago in December of last year.

Who:

Twenty-seven states, districts, and consortia of districts participated in the TIMSS 1999 Benchmarking Study. They are:

States	Districts and Consortia
Connecticut	Academy School District #20, Colorado Springs, CO
Idaho	Chicago Public Schools, IL
Illinois	Delaware Science Coalition, DE
Indiana	First in the World Consortium, IL
Maryland	Fremont/Lincoln/Westside Public Schools, NE
Massachusetts	Guilford County, NC
Michigan	Jersey City Public Schools, NJ
Missouri	Miami-Dade County Public Schools, FL
North Carolina	Michigan Invitational Group, MI
Oregon	Montgomery County, MD
Pennsylvania	Naperville Community Unit School District #203, IL
South Carolina	Project SMART Consortium, OH
Texas	Rochester City School District, NY
	Southwest Pennsylvania Math and Science Collaborative, PA

Why:

Participation in the TIMSS 1999 Benchmarking Study enabled states and districts to assess the comparative international standing of their eighth-grade students' mathematics and science knowledge. The TIMSS 1999 Benchmarking Study also provides state and local policymakers with rich information about strengths and weaknesses in performance, instructional practices, teacher preparation, curriculum, students' classroom experiences, and school policies.

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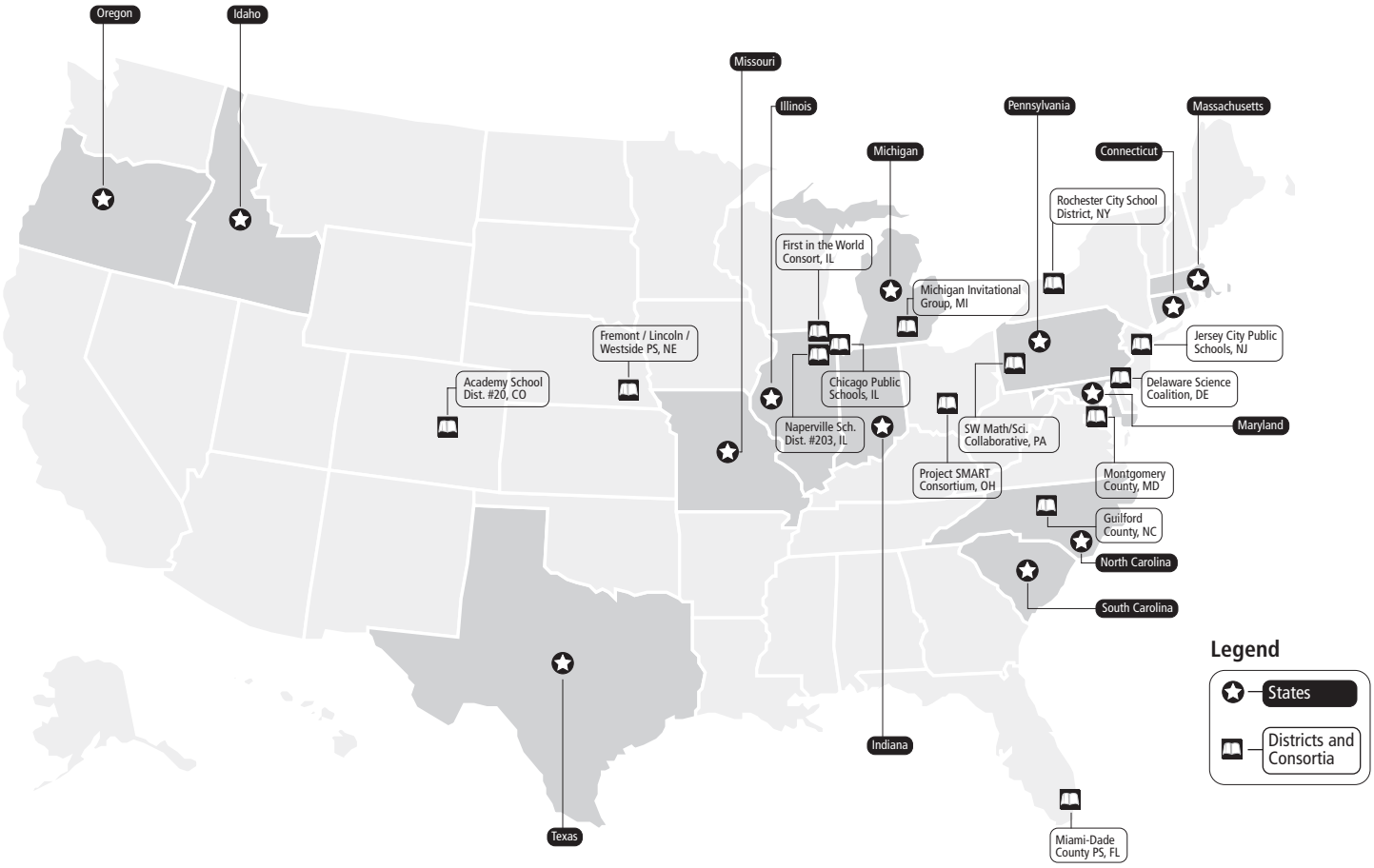
The TIMSS 1999 Benchmarking Study, supported by the National Center for Education Statistics and the National Science Foundation, is a collaborative effort between states, districts, and the TIMSS International Study Center at Boston College's Lynch School of Education.

Exhibit 1 Participants in TIMSS 1999 Benchmarking

8th Grade



TIMSS 1999 Benchmarking

States

- Connecticut
- Idaho
- Illinois
- Indiana
- Maryland
- Massachusetts
- Michigan
- Missouri
- North Carolina
- Oregon
- Pennsylvania
- South Carolina
- Texas

Districts and Consortia

- Academy School District #20, Colorado Springs, CO
- Chicago Public Schools, IL
- Delaware Science Coalition, DE
- First in the World Consortium, IL
- Fremont/Lincoln/Westside Public Schools, NE
- Guilford County, NC
- Jersey City Public Schools, NJ
- Miami-Dade County Public Schools, FL
- Michigan Invitational Group, MI
- Montgomery County, MD
- Naperville Community Unit School District #203, IL
- Project SMART Consortium, OH
- Rochester City School District, NY
- Southwest Pennsylvania Math and Science Collaborative, PA

TIMSS 1999

Countries

- Australia
- Belgium (Flemish)
- Bulgaria
- Canada
- Chile
- Chinese Taipei
- Cyprus
- Czech Republic
- England
- Finland
- Hong Kong, SAR
- Hungary
- Indonesia
- Iran, Islamic Republic
- Israel
- Italy
- Japan
- Jordan
- Korea, Republic of
- Latvia (LSS)
- Lithuania
- Macedonia, Republic of
- Malaysia
- Moldova
- Morocco
- Netherlands
- New Zealand
- Philippines
- Romania
- Russian Federation
- Singapore
- Slovak Republic
- Slovenia
- South Africa
- Thailand
- Tunisia
- Turkey
- United States

April
2001

TIMSS 1999 Benchmarking HighLights

A Bridge to School Improvement

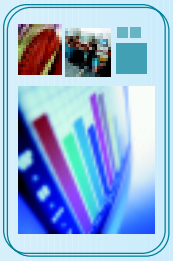
TIMSS 1999, a successor to the 1995 Third International Mathematics and Science Study (TIMSS), focused on the mathematics and science achievement of eighth-grade students. Thirty-eight countries including the United States participated in TIMSS 1999 (also known as TIMSS-Repeat or TIMSS-R). Even more significantly for the United States, however, TIMSS 1999 included a voluntary Benchmarking Study. Twenty-seven jurisdictions from all across the nation, including 13 states and 14 districts or consortia (see inside), participated in the Benchmarking Study.

Many states and school districts have been working on the arduous task of improving education in their jurisdictions. There has been concerted effort across the nation in writing and revising academic standards that has very much included attention to mathematics and science. Most states are in the process of implementing new content or curriculum standards or revising existing ones. Participation in the TIMSS 1999 Benchmarking Study provided an unprecedented opportunity for jurisdictions to assess the comparative international standing of their students' achievement and to evaluate their mathematics and science programs in an international context.

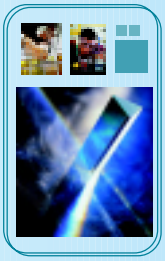
In 1999, the U.S. eighth graders performed significantly above the TIMSS international average in mathematics and science, but about in the middle of the achievement distribution of the 38 participating countries (above 17/18 countries, similar to 6/5, and below 14 in both subjects). In TIMSS 1999, the world class performance levels in mathematics were set essentially by five Asian countries – Singapore, the Republic of Korea, Chinese Taipei, Hong Kong SAR, and Japan. In science, four Asian countries and a central European one had the highest performance – Chinese Taipei, Singapore, Hungary, Japan, and the Republic of Korea.

Now Available...

Comparative results for the TIMSS 1999 Benchmarking Study in mathematics and science at the eighth grade are available in two companion reports.



Mathematics Benchmarking Report:
TIMSS 1999 – Eighth Grade



Science Benchmarking Report:
TIMSS 1999 – Eighth Grade

See back for more detailed information about reports from TIMSS 1999

Major Findings From The TIMSS 1999 BENCHMARKING STUDY

- Average performance in mathematics for the 13 Benchmarking states was generally clustered in the middle of the international distribution of results for the 38 countries. In mathematics, all of the Benchmarking states performed either significantly above or similar to the international average, yet significantly below the five high-performing Asian countries.

- In science, performance for the 13 states was relatively better than in mathematics, with performance clustered in the upper half of the international distribution. All but 3 states performed significantly above the international average.

- The Benchmarking Study underscores the extreme importance of looking beyond the averages to the range of academic achievement found across the United States. Performance across the participating school districts and consortia reflected nearly the full range of achievement internationally.

  - At the high end of the continuum in mathematics, although achievement was not as high as Singapore, Korea, and Chinese Taipei, the Naperville School District and the First in the World Consortium (both in Illinois) performed similarly to Hong Kong, Japan, Belgium (Flemish), and the Netherlands. In science, the Naperville School District and the First in the World Consortium, the Michigan Invitational Group, and the Academy School District (in Colorado) all had average achievement comparable to Chinese Taipei and Singapore.

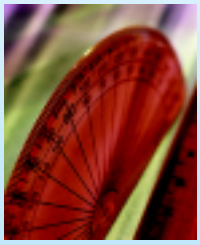
  - At the other end of the continuum in both mathematics and science, urban districts with high percentages of students from low-income families and minorities performed similarly to lower-performing countries in TIMSS 1999, but significantly higher than the lowest-scoring countries.

- In mathematics, students in the Benchmarking jurisdictions generally followed the national pattern of doing relatively less well in measurement and geometry than in fractions and number sense, data representation, and algebra. Similarly, they tended to perform relatively less well in physics than in the other science content areas.

Mathematics Achievement

Science Achievement

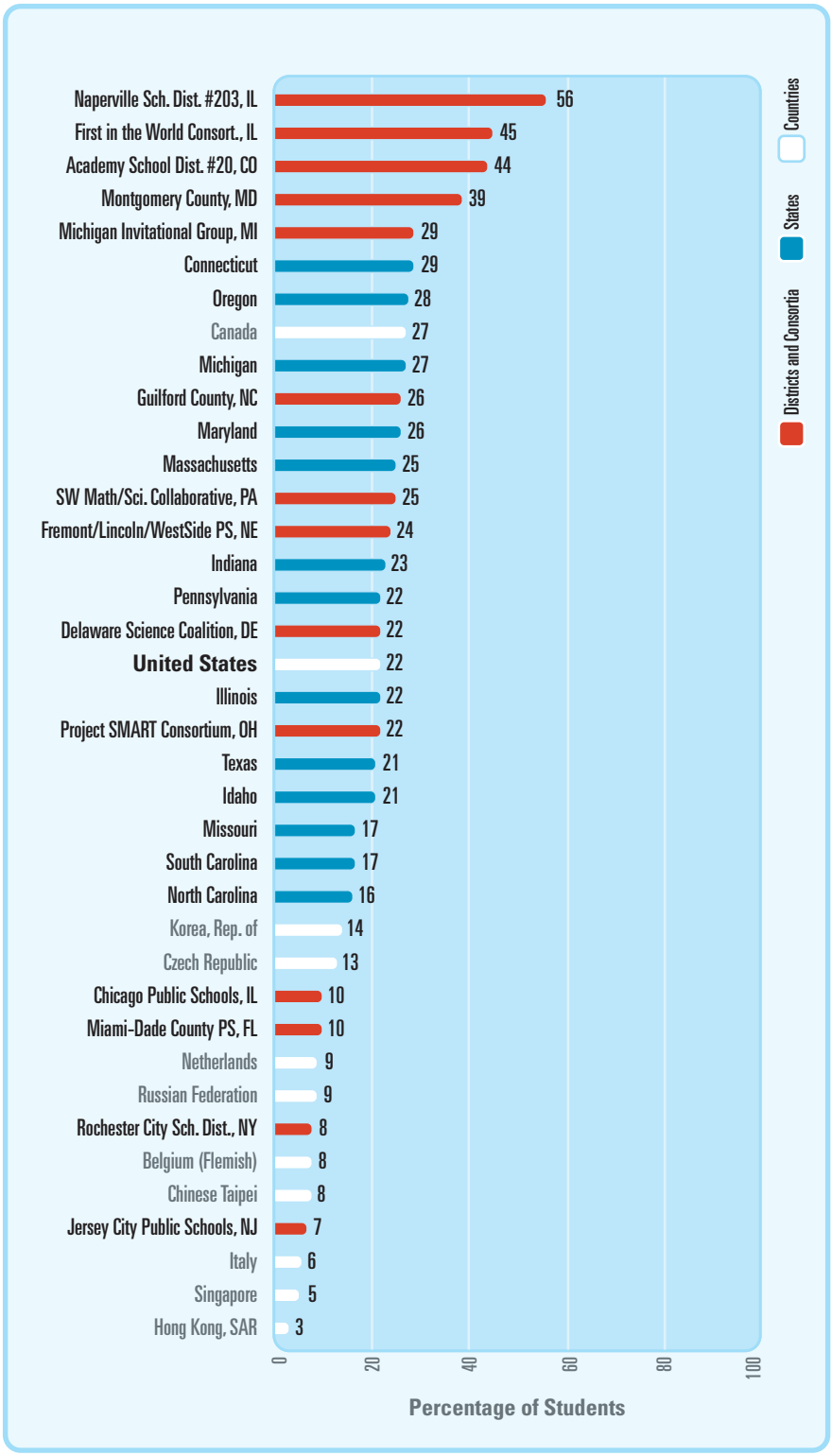
Improving students' opportunities to learn requires examining every aspect of the educational system, including the curriculum, teacher quality, availability and appropriateness of resources, students' motivation, instructional effectiveness, parental support, and school safety. There is no "magic bullet" or single factor that is the answer to higher achievement in mathematics or science. Raising achievement involves improvements in a number of important areas related to educational quality.



Disparities in Opportunities to Learn at Home and at School

- The TIMSS 1999 Benchmarking Study provides evidence that some schools in the U.S. are among the best in world, but that a world-class education is not available to all children. Students with fewer educational resources at home also often have fewer opportunities at school.
  - Benchmarking jurisdictions with more students from homes with high levels of educational resources were among the top-achievers in TIMSS 1999, and those with the lowest achievement were four urban districts that also had the lowest percentages of students with high levels of home educational resources (see opposite).
  - The results also support extensive research showing that students in urban districts often attend schools with fewer resources than in non-urban districts, including a less challenging curriculum and an atmosphere less conducive to learning.

High Level of Home Educational Resources



Results About Teaching and Learning

- Research shows higher student achievement in mathematics and science is associated with teachers having a university degree in the subject. Results varied dramatically across the Benchmarking entities. In the United States, however, students were more likely than students internationally to be taught by teachers with degrees in education or "other."

- In general, teachers in many Benchmarking entities and in the United States overall may be overconfident about their preparation to teach eighth-grade mathematics. Across the Benchmarking entities, the smallest percentage of students with teachers who felt "very well prepared" to teach mathematics was 75 percent – compared to the international average of 63 percent. The comparable figure for the U.S. was 87 percent. Teachers were less confident in their preparation to teach science. Just 27 percent in the U.S. felt "very well prepared," with a range across Benchmarking jurisdictions from 56 percent to 14 percent.

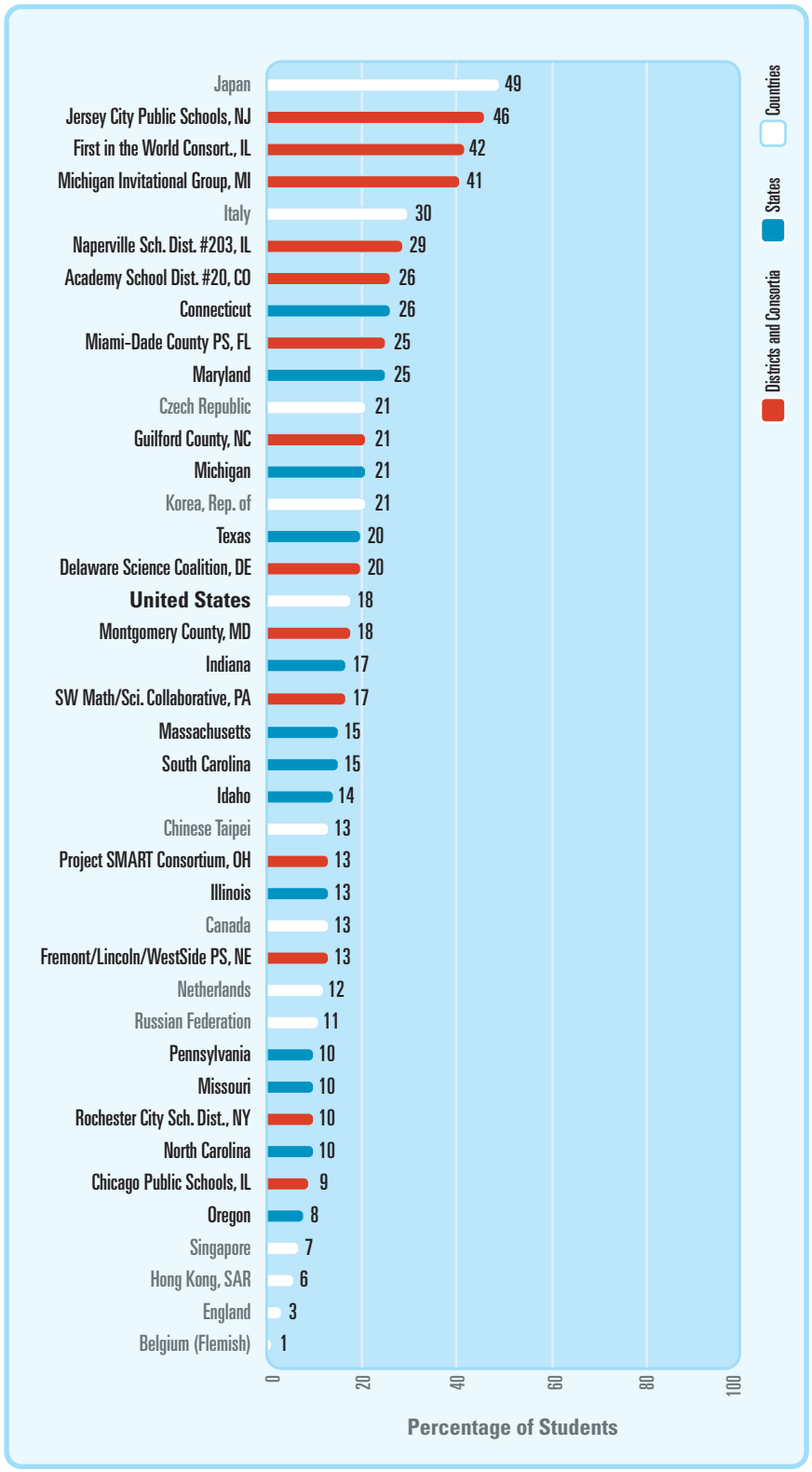
- The TIMSS data show that the instructional time for learning mathematics and science included considerable focus on lecture-style demonstrations by teachers and practice for students working on worksheets or textbooks. Instructional time is further eroded by interruptions. In Japan and Korea, more than half the students were in classes that never had interruptions for announcements or administrative tasks. Among the Benchmarking participants, the results ranged from 22 percent of the eighth graders in such classes in Naperville to only 5 percent in the Jersey City Public Schools.

- The choices teachers make determine, to a large extent, what students learn.

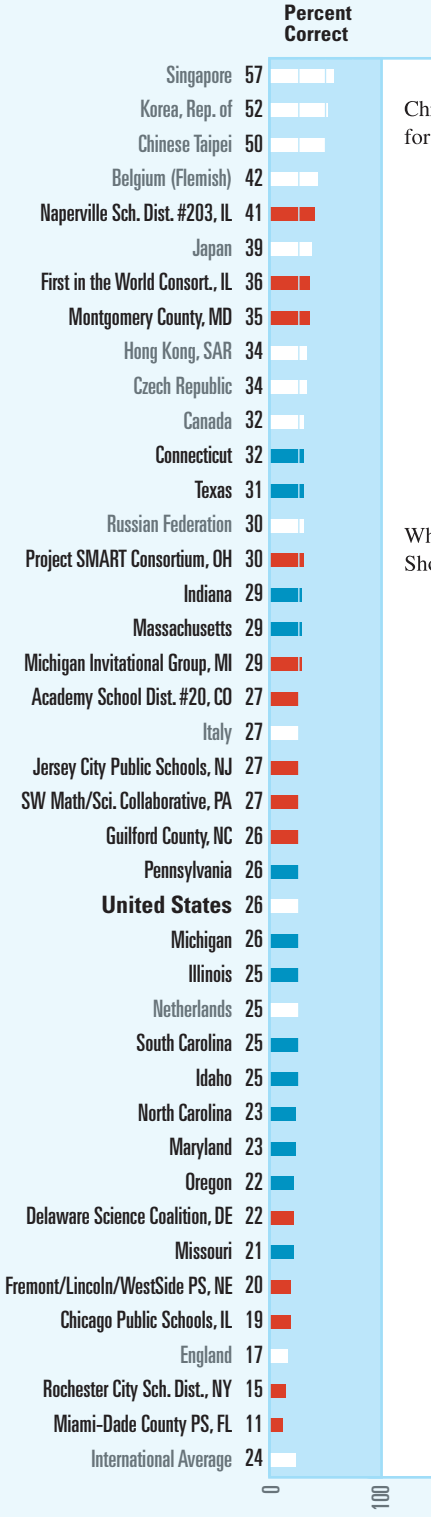
  - The TIMSS Benchmarking data show higher mathematics achievement when teachers emphasize reasoning and problem solving activities. About half the Japanese students had teachers who reported a high degree of emphasis on reasoning activities in their mathematics classes, more than in any other country. The emphasis on problem-solving varied dramatically across Benchmarking participants. At the top end, between 41 and 46 percent of the students in Jersey City, the First in the World Consortium, and the Michigan Invitational Group had teachers who reported a high degree of emphasis (see opposite).

  - Higher science achievement was related to the emphasis that teachers place on experiments or practical investigations. There also was great variation among the Benchmarking participants in the percent of students in science classes with a high degree of emphasis on scientific investigation, from 79 percent in Naperville, more than in any TIMSS 1999 country, to 17 percent in the Delaware Science Coalition.

High Emphasis on Reasoning and Problem Solving in Math Class



Mathematics: Example Item 1



Chris plans to order 24 issues of a magazine. He reads the following advertisements for two magazines. *Ceds* are the units of currency in Chris' country.

Teen Life Magazine

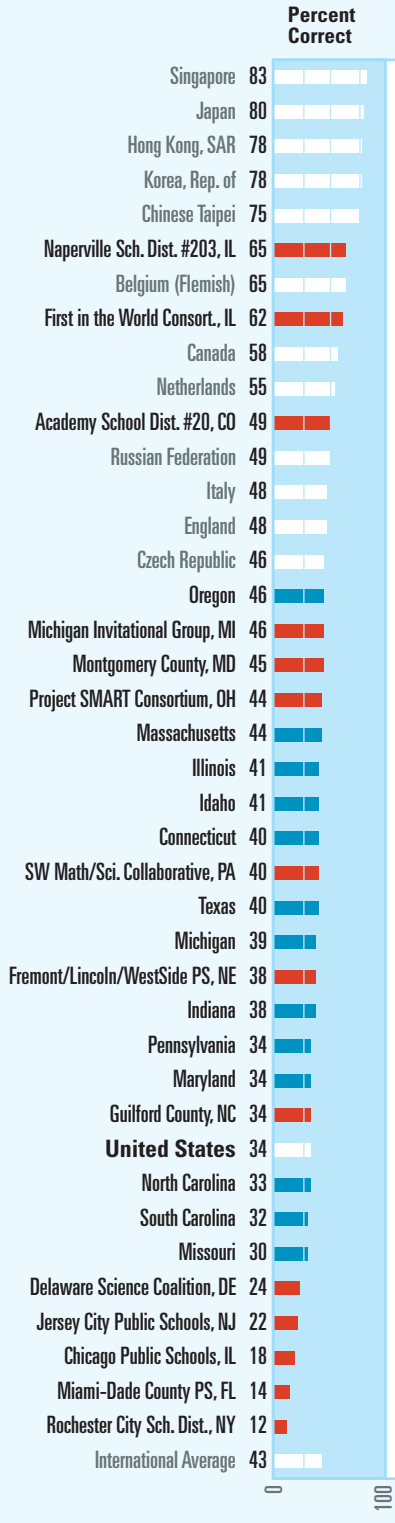
24 issues
First four issues FREE
The rest
3 *ceds* each.

Teen News Magazine

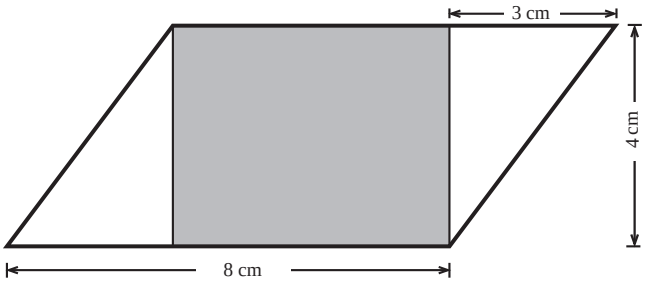
24 issues
First six issues FREE
The rest
3.5 *ceds* each.

Which magazine is the least expensive for 24 issues? How much less expensive? Show your work.

Mathematics: Example Item 2



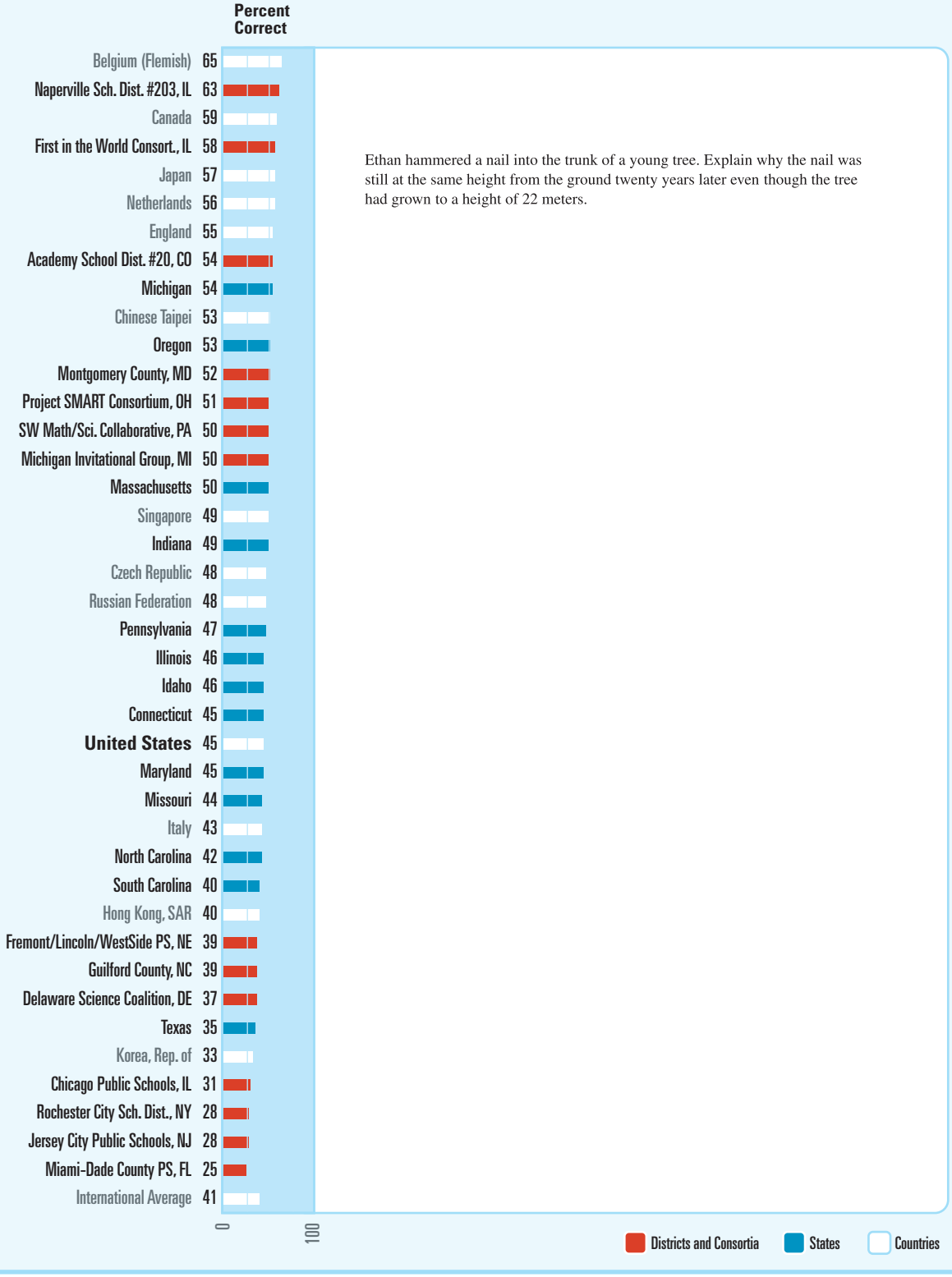
The figure shows a shaded rectangle inside a parallelogram.



What is the area of the shaded rectangle?

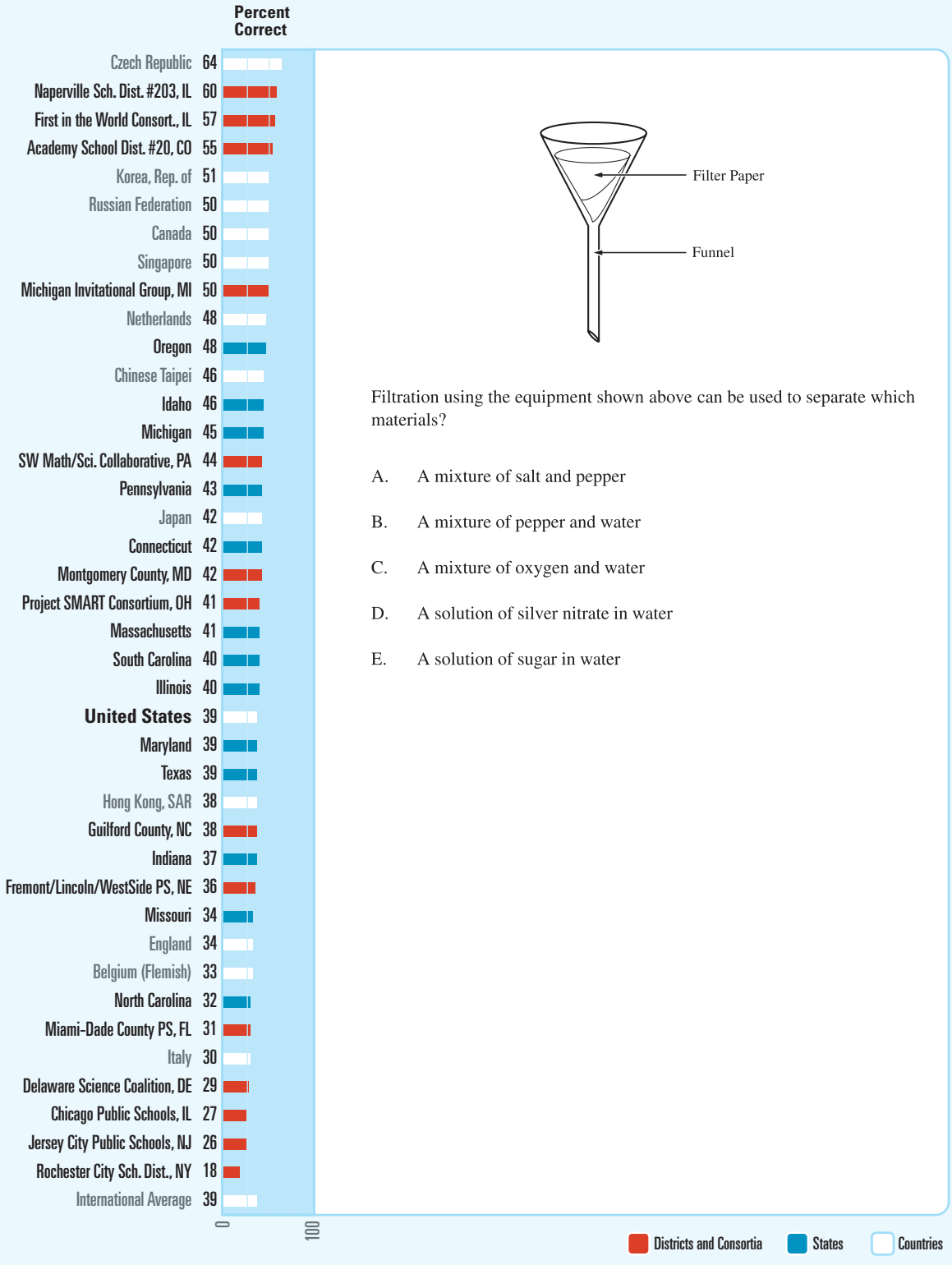
Answer: _____

Science: Example Item 3



Ethan hammered a nail into the trunk of a young tree. Explain why the nail was still at the same height from the ground twenty years later even though the tree had grown to a height of 22 meters.

Science: Example Item 4



Filtration using the equipment shown above can be used to separate which materials?

A. A mixture of salt and pepper

B. A mixture of pepper and water

C. A mixture of oxygen and water

D. A solution of silver nitrate in water

E. A solution of sugar in water

The TIMSS studies are projects of the International Association for the Evaluation of Educational Achievement (IEA). The IEA is an independent international cooperative of national research institutions and government agencies. Since its inception in 1959, the IEA has conducted more than 15 studies of cross-national achievement.

The International Study Center at Boston College is dedicated to conducting comparative studies in educational achievement. Principally, it serves as the International Study Center for IEA's studies in mathematics, science, and reading - the Trends in Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS).

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