

TIMSS Highlights from the Primary Grades

THIRD INTERNATIONAL MATHEMATICS AND SCIENCE STUDY

Most Recent Publications

International comparative results in mathematics and science achievement are now available for third- and fourth-grade students around the world. The TIMSS International Study Center recently has released two companion reports:



Mathematics Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study



Science Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study

These two reports describe student achievement in mathematics and science, respectively, for third and fourth graders in 26 countries. Results are presented for major content areas within each subject, and include breakdowns by gender. Country-by-country results are displayed for example items to illustrate the range of topics covered. Results are included for selected background and attitudinal factors for fourth-grade students. Information also is provided about teacher characteristics and instructional practices.

The third- and fourth-grade reports parallel the seventh- and eighth-grade reports published in November 1996. Taken together, the reports provide a comprehensive international perspective on student achievement in mathematics and science from the primary through the middle school years.

Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study

Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study

During the coming months, the TIMSS International Study Center also will publish results for the performance assessment tasks given at the fourth and eighth grades. Achievement results for students in the final year of secondary school will follow in early 1998. The secondary school report will contain performance results in mathematics and science literacy, physics, and advanced mathematics.

High Achieving Countries

In mathematics, Singapore and Korea were the top-performing countries at both the fourth and third grades. Japan and Hong Kong also performed among the best in the world, as did the Netherlands, the Czech Republic, and Austria.

Nine of the twelve countries that performed above the international average in mathematics at the fourth grade also did so at the eighth grade, including Singapore, Korea, Japan, Hong Kong, the Netherlands, the Czech Republic, Austria, Slovenia, and Hungary. Of the other three, Ireland and Australia were around the international average at the eighth grade, while the United States was below it.

In science, Korea was the top-performing country at both the fourth and third grades. Japan, the United States, Austria, and Australia also performed very well at both grades.

In science, Korea, Japan, Austria, Australia, the Czech Republic, England, Singapore, and Slovenia performed above the international average at both the fourth and eighth grades. The exceptions were Canada, Ireland, Scotland, and the United States, which were above the international average at the fourth grade, but just at the average at the eighth grade.

Table 1

Achievement in the Primary School Years

Table 2

science

Fourth Grade*		Third Grade*	
Country	Average Achievement	Country	Average Achievement
Korea	597	Korea	553
Japan	574	Japan	522
United States	565	United States	511
<i>Austria</i>	565	<i>Australia</i>	510
<i>Australia</i>	562	<i>Austria</i>	505
<i>Netherlands</i>	557	England	499
Czech Republic	557	<i>Netherlands</i>	499
England	551	Czech Republic	494
Canada	549	Canada	490
Singapore	547	Singapore	488
<i>Slovenia</i>	546	<i>Slovenia</i>	487
Ireland	539	<i>Scotland</i>	484
Scotland	536	Hong Kong	482
Hong Kong	533	Ireland	479
<i>Hungary</i>	532	New Zealand	473
New Zealand	531	<i>Latvia (LSS)</i>	465
Norway	530	<i>Hungary</i>	464
<i>Latvia (LSS)</i>	512	Norway	450
<i>Israel</i>	505	Greece	446
Iceland	505	Iceland	435
Greece	497	<i>Thailand</i>	433
Portugal	480	Portugal	423
Cyprus	475	Cyprus	415
<i>Thailand</i>	473	Iran, Islamic Republic	356
Iran, Islamic Republic	416		
<i>Kuwait</i>	401		
International Average 524		International Average 473	

mathematics

Fourth Grade*		Third Grade*	
Country	Average Achievement	Country	Average Achievement
Singapore	625	Korea	561
Korea	611	Singapore	552
Japan	597	Japan	538
Hong Kong	587	Hong Kong	524
<i>Netherlands</i>	577	Czech Republic	497
Czech Republic	567	<i>Netherlands</i>	493
<i>Austria</i>	559	<i>Slovenia</i>	488
<i>Slovenia</i>	552	<i>Austria</i>	487
Ireland	550	<i>Australia</i>	483
<i>Hungary</i>	548	United States	480
<i>Australia</i>	546	<i>Hungary</i>	476
United States	545	Ireland	476
Canada	532	Canada	469
<i>Israel</i>	531	<i>Latvia (LSS)</i>	463
<i>Latvia (LSS)</i>	525	<i>Scotland</i>	458
Scotland	520	England	456
England	513	<i>Thailand</i>	444
Cyprus	502	New Zealand	440
Norway	502	Cyprus	430
New Zealand	499	Greece	428
Greece	492	Portugal	425
<i>Thailand</i>	490	Norway	421
Portugal	475	Iceland	410
Iceland	474	Iran, Islamic Republic	378
Iran, Islamic Republic	429		
<i>Kuwait</i>	400		
International Average 529		International Average 470	

Achievement in Science

Achievement in Mathematics

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.



*Fourth and third grades in most countries. Latvia is annotated LSS for Latvian Speaking Schools only. Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures. The report presents standard errors for all survey estimates.

KEY FINDINGS

For most countries, gender differences in mathematics achievement were small or essentially non-existent. In science, the gender differences at third and fourth grades were much less pervasive than at the seventh and eighth grades. However, boys had significantly higher achievement than girls at both grades in about half the countries, particularly in earth science and physical science.

The overwhelming majority of fourth graders in nearly every country indicated that they liked mathematics and science. In most countries, boys and girls were equally positive about liking each of these subjects.

Just as at the eighth grade, having educational resources in the home was strongly related to mathematics and science achievement in every country (i.e., computer, dictionary, own study desk, and 100 or more books in the home).

For normal school days, fourth-grade students in most countries reported averaging approximately an hour outside of school each day studying or doing homework in mathematics. They reported spending between half an hour and an hour studying or doing homework in science.

Teachers in most countries reported that mathematics classes typically meet for three or four hours a week, on average. In comparison, teachers in about half the countries reported that science is taught for less than two hours a week. In about one-fifth of the countries, science instruction for most students is integrated with the teaching of other subjects.

In most countries, the majority of fourth-grade students were taught mathematics and science by female teachers. Most often, the two subjects were taught by the same teacher.

In both mathematics and science, small-group work was used less frequently than other instructional approaches. Across countries, teachers reported that working together as a class with the teacher teaching the whole class, and having students work individually with assistance from the teacher were the most frequently used instructional approaches.

In most countries, the challenge of catering to students of different academic abilities was the factor teachers mentioned most often as limiting how they teach their mathematics and science classes. Other limiting factors were a high student/teacher ratio, a shortage of equipment for use in instruction, and the burden of dealing with disruptive students.

The textbook was the major written source mathematics teachers used in deciding how to present a topic to their classes. Relatively uniformly, the majority of students were asked both to practice computation and to do some type of reasoning task in most or every lesson.

About TIMSS

Since its inception in 1959, the International Association for the Evaluation of Educational Achievement (IEA) has conducted a series of international comparative studies designed to provide information to policy-makers, educators, researchers, and practitioners about educational achievement and learning contexts.

TIMSS is the largest and most ambitious of these studies ever undertaken. The successful collaboration of research centers around the world in implementing TIMSS is a tribute to the dedication and professionalism of all involved. All told, TIMSS achievement testing in mathematics and science included:

- 45 countries
- 5 grade levels (3rd, 4th, 7th, 8th, and final year of secondary school)
- more than half a million students
- testing in more than 30 different languages
- more than 15,000 participating schools
- performance assessment

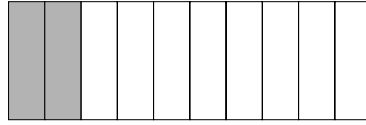
- questionnaires from students, teachers, and school principals containing about 1,500 questions
- many thousands of individuals to give the tests and process the data

TIMSS was conducted with attention to quality at every step of the way. Rigorous procedures were designed specifically to translate the tests, and numerous regional training sessions were held in data collection and scoring procedures. Quality control observers monitored testing sessions. The samples of students selected for testing were scrutinized according to rigorous standards designed to prevent bias and ensure comparability.

The international direction of TIMSS is funded by the National Center for Education Statistics of the U.S. Department of Education, the U.S. National Science Foundation, and the Canadian Government. Each country provides its own funding for the national implementation of TIMSS.

TIMSS Publications are available on the World Wide Web:
wwwcsteep.bc.edu/timss

1



Which number represents the shaded part of the figure?

- A. 2.8
- B. 0.5
- C. 0.2
- D. 0.02

Even though fourth graders in the top-performing countries had very high achievement on many of the test questions, students generally had the most difficulty with the items in the content area of fractions and proportionality. In particular, items involving decimals were challenging (Example Item 1). In only five countries (Hong Kong, Japan, Korea, Portugal, and Singapore) did more than half the students identify 0.2 as the number representing the shaded part of the figure.

In data representation, students had some difficulty moving beyond a straight-forward reading of data in tables, charts, and graphs to actually using such information in calculations or to graphically represent the data (Example Item 2). On average, 40% of the fourth graders and 23% of the third graders across countries drew the four bars to appropriate heights. However, about three-fourths or more of the fourth graders completed the bar graph in Hong Kong, Japan, Korea, and Singapore.

2

This table shows the ages of the girls and boys in a club.

Age	Number of Girls	Number of Boys
8	4	6
9	8	4
10	6	10

Use the information in the table to complete the graph for ages 9 and 10.

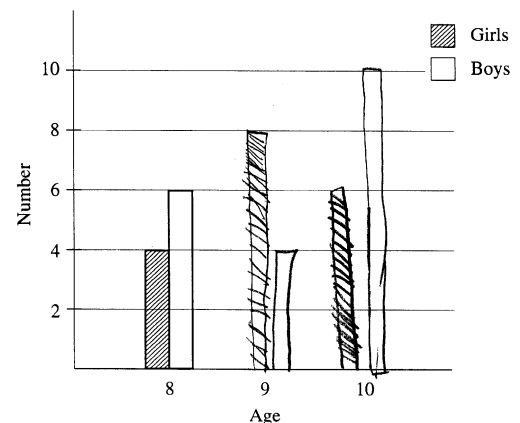


Table 3

Percent Correct on Selected Mathematics Items Fourth Grade*

Country	Example 1	Example 2	Example 3
<i>Australia</i>	40	50	36
<i>Austria</i>	34	39	41
Canada	40	46	38
Cyprus	41	30	29
Czech Republic	31	33	57
England	34	49	35
Greece	30	28	24
Hong Kong	73	75	--
<i>Hungary</i>	31	31	56
Iceland	23	36	24
Iran, Islamic Republic	35	1	29
Ireland	48	34	38
<i>Israel</i>	28	37	45
Japan	71	78	50
Korea	67	83	70
<i>Kuwait</i>	32	8	20
<i>Latvia (LSS)</i>	30	31	53
<i>Netherlands</i>	32	42	41
New Zealand	25	48	27
Norway	19	26	30
Portugal	71	13	32
Scotland	34	45	31
Singapore	81	74	54
<i>Slovenia</i>	29	32	47
<i>Thailand</i>	35	38	37
United States	32	55	32
International Average	40	41	39

*Fourth grade in most countries.

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Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures. The report presents standard errors for all survey estimates.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Similarly, students were more likely to be able to recognize simple patterns and relationships than they were to determine the operations underlying the relationships (Example Item 3). When given two columns of four numbers, only about one-fourth of the third graders and two-fifths of the fourth graders correctly determined that you needed to divide the number in Column A by 5 to obtain the number next to it in Column B.

What do you have to do to each number in Column A to get the number next to it in Column B?

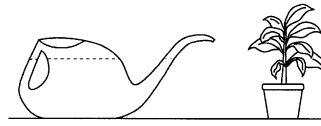
Column A	Column B
10	2
15	3
25	5
50	10

- A. Add 8 to the number in Column A.
- B. Subtract 8 from the number in Column A.
- C. Multiply the number in Column A by 5.
- D. Divide the number in Column A by 5.

3

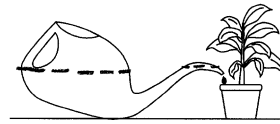
A watering can is almost filled with water as shown.

4



The watering can is tipped so that the water just begins to drip through the spout.

Draw a line to show where the surface of the water in the can is now.



Internationally, students found many of the physical science items quite challenging. For example, an item that required students to understand what happens to the level of water in a watering can as the can is tilted was answered correctly by about one-fifth of fourth-grade students, on average (Example Item 4). Only in Singapore did more than 30% of fourth-grade students correctly draw a line showing the level of water in the tilted can.

5

Write down one thing your heart does that helps the other parts of your body.

Your heart pumps blood to all parts of your body.

In general, students had slightly less difficulty with the life science items, although there were some difficult items. A free-response item requiring students to write one thing that the heart does to help other parts of the body was answered correctly by 28% of the third-grade students and 40% of fourth graders (Example Item 5). Only in Australia, England, and the United States did more than 60% of the students correctly mention the heart's role in pumping blood around the body.

Table 4

Percent Correct on Selected Science Items Fourth Grade*

Country	Example 4	Example 5	Example 6
<i>Australia</i>	20	69	70
<i>Austria</i>	25	57	79
Canada	22	49	68
Cyprus	13	18	54
Czech Republic	28	35	76
England	29	61	72
Greece	17	34	67
Hong Kong	28	14	87
<i>Hungary</i>	26	30	78
Iceland	17	33	64
Iran, Islamic Republic	10	23	56
Ireland	19	49	69
<i>Israel</i>	13	37	52
Japan	27	39	58
Korea	26	34	76
<i>Kuwait</i>	8	12	58
<i>Latvia (LSS)</i>	30	33	62
<i>Netherlands</i>	28	36	81
New Zealand	17	53	64
Norway	21	51	85
Portugal	20	27	77
Scotland	15	53	63
Singapore	32	59	86
<i>Slovenia</i>	25	49	72
<i>Thailand</i>	15	13	64
United States	21	64	75
International Average	21	40	70

*Fourth grade in most countries.

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SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

One of the relatively easier earth science items asked student to indicate why the moon shines at night even though it produces no light (Example Item 6). About two-thirds of both third and fourth graders correctly recognized that the moon reflects the light of the sun. More than 80% of the fourth-grade students in Hong Kong, the Netherlands, Norway, and Singapore answered this item correctly.

The Moon produces no light, and yet it shines at night. Why is this?

- A. The Moon reflects the light from the Sun.
- B. The Moon rotates at a very high speed.
- C. The Moon is covered with a thin layer of ice.
- D. The Moon has many craters.

6