

# Executive Summary



TIMSS 2007 is the fourth in a continuing cycle of international mathematics and science assessments conducted every four years. TIMSS assesses achievement in countries around the world and collects a rich array of information about the educational contexts for learning mathematics and science, with TIMSS 2007 involving more than 60 participants. This report contains the mathematics results for 37 countries and 7 benchmarking participants at the fourth grade and for 50 countries and 7 benchmarking participants at the eighth grade. Trend data are provided at the fourth and eighth grades for those countries that also participated in 1995, 1999, and 2003 (please see the Introduction for more information about TIMSS 2007).

## **Mathematics Achievement**

- ▶ At the fourth grade, Hong Kong SAR and Singapore were the top performing countries. They were followed by Chinese Taipei, that had higher average mathematics achievement than all countries except Hong Kong SAR and Singapore, and, in turn, by Japan, that had higher achievement than all of the remaining countries. Kazakhstan, the Russian Federation, England, Latvia, and the Netherlands also performed very well. Several benchmarking participants also had high average mathematics achievement, including the U.S. state of Massachusetts, which performed similarly to Chinese Taipei and the state of Minnesota, which performed similarly to Kazakhstan, the Russian Federation, and England.

- ▶ At the eighth grade, Chinese Taipei, Korea, and Singapore had the highest average mathematics achievement. These three countries were followed by Hong Kong SAR and Japan, also performing similarly and having higher achievement than all the other countries except the top three performers. There was a substantial gap in average mathematics achievement between the five Asian countries and the next group of four similarly performing countries, including Hungary, England, the Russian Federation, and the United States. Among the benchmarking participants, the two U.S. states, Massachusetts and Minnesota, and the province of Quebec were outperformed by the five Asian countries but had higher average achievement than the group of four countries. The provinces of Ontario and British Columbia had average achievement similar to the group of four countries.
- ▶ Remarkable percentages of students in Asian countries reached the Advanced International Benchmark for mathematics, representing fluency on items involving the most complex topics and reasoning skills. In particular, at the fourth grade, Singapore and Hong Kong SAR had 41 and 40 percent of their students, respectively, achieving at or above the Advanced International Benchmark. At the eighth grade, Chinese Taipei, Korea, and Singapore had 40 to 45 percent of their students achieving at or above the Advanced International Benchmark. The median percentage of students reaching this Benchmark was 5 percent at the fourth grade and 2 percent at the eighth grade.
- ▶ Looking at trends across all of the participating countries, not taking into account whether countries have participated in two, three, or four cycles (eighth grade) of TIMSS, more countries showed improvement in average achievement between their first cycle of participation and TIMSS 2007 than declines at the fourth grade, although this was not the pattern at the eighth grade. At the fourth grade, 10 countries had higher average achievement in 2007 than in their first TIMSS assessment, 5 had lower average achievement, and 8 showed no significant change. At the eighth grade, 10 countries had higher average achievement in 2007 than in their initial assessment, 15 lower average achievement, and 11 showed no significant change.

- ▶ At the fourth grade, there was no difference in average mathematics achievement between boys and girls, on average across the TIMSS 2007 countries. In approximately half the countries, the difference in average achievement was negligible. Girls had higher mathematics achievement than boys in 8 countries and boys had higher achievement than girls in 12 countries. At the eighth grade, on average, girls had higher achievement than boys. Girls had higher average mathematics achievement than boys in 16 countries and boys had higher achievement than girls in 8 countries.

### **Factors Associated with Higher Achievement in Mathematics**

- ▶ At both fourth and eighth grades, on average across countries, a large majority of students reported always or almost always speaking the language of the test at home, and these students had higher average mathematics achievement than those who reported speaking it less frequently. Also, students from homes with more books had higher average mathematics achievement than those from homes with fewer books.
- ▶ At the eighth grade, higher levels of parents' education were associated with higher average mathematics achievement in almost all countries.
- ▶ On average across countries at the fourth and eighth grades, students from homes with a computer had higher mathematics achievement than those from homes without a computer, and those from homes with an Internet-connected computer had higher achievement than students from homes without such a facility. Average achievement was highest among those reporting using a computer at home and at school and at home only, perhaps reflecting an economic advantage for those with a computer at home, and lowest among those reporting that they do not use a computer at all or use one only at places other than the home and the school. At both grades, computer use increased in a number of countries between 2003 and 2007.
- ▶ Students generally had positive attitudes toward mathematics, on average across countries (72% at the high level at fourth grade and 54% at

eighth grade), and those with more positive attitudes had higher average mathematics achievement than students with less positive attitudes. There also was a positive association between level of self-confidence in learning mathematics and mathematics achievement at both grades. Further, eighth grade mathematics achievement was higher for students who reported placing a higher value on mathematics.

- ▶ At both grades, on average, there was a positive association between attending schools with fewer students from economically disadvantaged homes and mathematics achievement. Also, achievement was highest among students attending schools with more than 90 percent of students having the language of the test as their native language.
- ▶ Average mathematics achievement was highest among students attending schools with few attendance problems and lowest among students attending schools where there were serious problems with students arriving late, absenteeism, and missing class. Such problems appear to be more serious at the eighth grade.
- ▶ Principals were asked the degree to which shortages or inadequacies in resources affected their schools' general capacity to provide instruction. At both grades, average mathematics achievement was highest among students in schools where principals reported that resource shortages were not a problem. Also, there was an association between higher average achievement and more positive teachers' reports about the adequacy of their working conditions.
- ▶ At both fourth and eighth grades, mathematics achievement was highest, on average, where principals and teachers had a positive view of the school climate. At the eighth grade, teachers had a somewhat less positive outlook on climate than principals. There was a positive association between average mathematics achievement and students' perception of being safe in school at both fourth and eighth grades.

## Mathematics Curriculum and Instruction

- ▶ At the fourth grade, there was some variation, but countries' prescribed curricula averaged 23 hours of total instruction per week, with about one fifth of the time (18%) being for mathematics instruction. Generally, there was very close agreement between the curriculum and teachers' reports about its implementation. On average internationally, fourth grade teachers reported a total of 24 hours of weekly instruction, with 16 percent being devoted to mathematics. At the eighth grade, the prescribed instructional time per week averaged 27 hours, with 14 percent for mathematics instruction. Teachers' reports of 28 hours per week in total and 12 percent for mathematics instruction corresponded closely.
- ▶ At the fourth grade, on average across countries, teachers reported devoting half the mathematics instructional time to the content area of number, about one fourth (24%) to geometric shapes and measures, 16 percent to data display, and 10 percent to other areas. At the eighth grade, on average internationally, teachers reported devoting 24 percent of the mathematics instructional time to number, 29 percent to algebra, 27 percent to geometry, 13 percent to data and chance, and 7 percent to other areas.
- ▶ For most countries, much of the mathematics content assessed by TIMSS was included in their intended curriculum. On average across countries at the fourth grade, the majority of the assessment topics (22 out of 35) were intended for all or almost all students. At the eighth grade, on average across countries, most of the assessment topics (31 out of 39) were intended for all or almost all students.
- ▶ According to their teachers, 66 percent of fourth grade students and 72 percent of eighth grade students, on average across countries, had been taught the mathematics topics assessed.
- ▶ At both the fourth and eighth grades, the majority of students were taught mathematics by teachers in their 30s and 40s. Although about one fourth of the students internationally were taught by teachers 50 or older, relatively few students were taught by younger teachers. On

average, internationally, 70 percent of the fourth grade students and 78 percent of the eighth grade students had teachers with a university degree. However, there was some variation at the fourth grade.

- ▶ Most countries have a national or regional mathematics curriculum, and most countries reported that teachers received specific preparation in how to teach the mathematics curriculum as part of pre-service education. At the eighth grade, on average internationally, most students had teachers who had studied mathematics (70%) and/or mathematics education (54%). However, in a number of countries, the teachers of the fourth grade students reported little specific training or specialized education in mathematics.
- ▶ At the fourth grade, on average internationally, 72 percent of the students were taught by teachers who reported feeling very well prepared to teach the mathematics topics in the TIMSS assessment. At the eighth grade, 79 percent of the students had teachers who reported being very well prepared to teach the TIMSS mathematics topics.
- ▶ The textbook remains the primary basis of mathematics instruction at both the fourth and eighth grades. On average internationally, 65 percent of the students at fourth grade and 60 percent at eighth grade had teachers who reported using a textbook as the primary basis of their lessons. For another 30 percent of the fourth grade students and 34 percent of the eighth grade students, teachers reported using textbooks as a supplementary resource.
- ▶ At the fourth grade, internationally on average, most time in mathematics class was spent on having students work on problems with teacher guidance (21%) and having students work on solving problems independently (22%). According to teachers, considerable time also was spent on listening to lectures (16%) and clarifications of content and procedures (13%). Together, these four activities accounted for 69 to 72 percent of the class time at both the fourth and eighth grades. At the eighth grade, the distribution involved slightly more time listening to lectures (20%) and slightly less on independent problem solving (16%).
- ▶ Most countries do not permit calculators in mathematics classes at the fourth grade; however, even in the high use countries, teachers reported

asking only small percentages of students to do calculator activities on a regular basis. At the eighth grade, almost all countries permit calculator usage for the majority of eighth grade students. On average internationally, teachers asked the greatest percentages of students to use calculators in solving complex problems (31%), checking answers (26%), and doing routine computations (25%). Only 16 percent, on average, were asked to explore number concepts.

- ▶ At the fourth grade, mathematics homework was not very prevalent and there was little relationship between teachers' emphasis on homework and student achievement. At the eighth grade, there was a positive relationship between teachers assigning more homework and mathematics achievement. However, a number of countries were assigning less homework in 2007 than in 2003.
- ▶ At the eighth grade, teachers used classroom tests to some extent for nearly all of the students. According to teachers' reports, 85 percent of eighth grade students were given mathematics tests at least monthly, on average internationally. Nearly half were given a mathematics test or examination every two weeks (or more frequently). On average, 44 percent of the students were taught by teachers who reported testing them with only or mostly constructed-response items, another 41 percent by teachers who reported using about half constructed-response and half multiple-choice items, and only 15 percent by teachers who reported using only or mostly multiple-choice items.

