

EXECUTIVE SUMMARY

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TIMSS 1999
International
Mathematics
Report





Executive Summary

In 1999, the Third International Mathematics and Science Study (TIMSS) was replicated at the eighth grade. Involving 41 countries and testing at five grade levels, TIMSS was originally conducted in 1995 to provide a base from which policy makers, curriculum specialists, and researchers could better understand the performance of their educational systems. Conducted under the auspices of the International Association for the Evaluation of Educational Achievement (IEA), TIMSS was the first step in a long-term strategy, with further assessments in mathematics and science planned for 1999, 2003, and beyond.

TIMSS 1999, also known as TIMSS-Repeat or TIMSS-R, was designed to provide trends in eighth-grade mathematics and science achievement in an international context. Thirty-eight countries participated in TIMSS 1999. Of these, 26 countries also participated in TIMSS 1995 at the eighth grade and have trend data included in this report. Also, 1999 represents four years since the first TIMSS, and the population of students originally assessed as fourth-graders had advanced to the eighth grade. Thus, for 17 of the 26 countries that participated in TIMSS 1995 at the fourth grade, TIMSS 1999 also provides information about whether the relative performance of these students has changed in the intervening years.

Five content areas were covered in the TIMSS 1999 mathematics test: fractions and number sense; measurement; data representation, analysis, and probability; geometry; and algebra. About one-fourth of the questions were in the free-response format, requiring students to generate and write their answers. (See Chapter 2 for example items illustrating the range of mathematics concepts and processes covered in the TIMSS 1999 tests.) The achievement data are accompanied by extensive questionnaire data about the home, classroom, school, and national contexts within which mathematics learning takes place.

Because a valid and efficient sample in each country is crucial to the quality and integrity of the study, TIMSS developed procedures and standards regarding coverage of the target population, participation, and the age and years of schooling of students. For 1999, all countries met the guidelines, and any variations that occurred are annotated. Indeed, TIMSS 1999 was conducted with rigorous attention to attaining high quality in all aspects of the project.

Students' Mathematics Achievement

- ▶ Singapore, the Republic of Korea, Chinese Taipei, and Hong Kong SAR had the highest average performance, with Singapore and Korea having significantly higher achievement than all other participating countries. Japan also performed very well as did Belgium (Flemish) (see Exhibits 1.1 and 1.2).
- ▶ Countries that showed an increase in average mathematics achievement between 1995 and 1999 were Latvia (LSS)¹, Canada, and Cyprus. Only the Czech Republic showed a decrease.
- ▶ The difference in average achievement for boys and girls was negligible in most countries, except Israel, the Czech Republic, Tunisia, and the Islamic Republic of Iran. The gender differences among high-performing students, although small, were statistically significant, with 27 percent of boys on average across countries in the top achievement quarter, compared with 23 percent of girls. Since boys and girls showed similar increases across countries from 1995 to 1999, the average gender difference remained essentially the same. Korea was the one country that narrowed the gender gap in average mathematics achievement.

¹ Because coverage of the target population falls below 65%, Latvia is annotated LSS for Latvian-Speaking Schools only.

Students' Home Environment and Attitudes Towards Mathematics

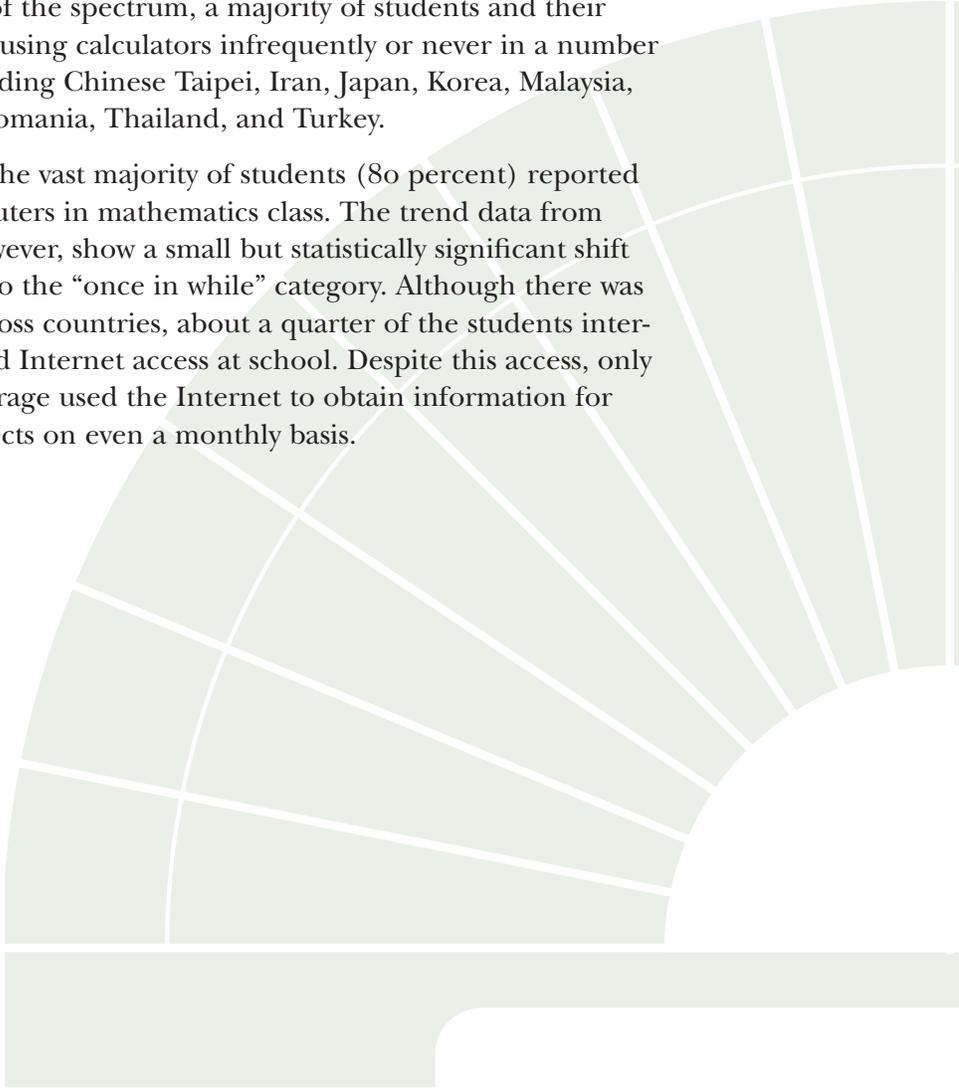
- ▶ On average internationally, students from homes with a high level of educational resources (more than 100 books; all three study aids: computer, study desk, and dictionary; and at least one parent finished university) had higher mathematics achievement than students from homes with fewer resources.
- ▶ Eighth-grade students internationally had high expectations for further education. On average across countries, more than half the students reported that they expected to finish university. In almost every country there was a positive association between educational expectations and mathematics achievement.
- ▶ Internationally on average, about 15 percent of the eighth-grade students seem to be convinced that they just cannot do mathematics. In each country, a more positive self-concept in mathematics was associated with higher average achievement. Interestingly, however, several countries with low percentages of students reporting a strong self-concept had high average mathematics achievement, including the five Asian Pacific countries (Singapore, Hong Kong, Chinese Taipei, Korea, and Japan).
- ▶ Across the participating countries, eighth-grade students generally had positive attitudes towards mathematics. More boys than girls reported high levels of positive attitudes towards mathematics internationally and in a number of countries. There was little change overall in students' attitudes between 1995 and 1999.

The Mathematics Curriculum

- ▶ In 35 of the 38 countries, specifications for students' curricular goals in mathematics were developed as national curricula. The exceptions were Australia, Canada, and the United States.
- ▶ Testing and assessment were widely used methods to support curriculum implementation. Belgium (Flemish) was the one country that reported having no public examinations in mathematics to certify students or select them for university or academic tracks. Approximately two-thirds of the countries conduct system-wide assessments at two or three grades, primarily to inform policy makers about achievement of the intended curriculum.
- ▶ On average across countries, the percentage of instructional time designated in official curricula for mathematics instruction remains about the same from grade 4 to grade 6 but then decreases by grade 8 (17, 16, and 13 percent, respectively). In contrast, the instructional time specified for science increases from grade 4 to grade 8 (from 11 to 16 percent).
- ▶ Across countries, the official curricula for eighth grade most commonly placed major emphasis on mastering basic skills and understanding mathematical concepts. Moderate to major emphasis was placed on assessing student learning, "real-life" applications of mathematics, and communicating mathematically. Thirty-three countries reported at least moderate emphasis on solving non-routine problems, but working on mathematics projects was given minor or no emphasis in the intended curriculum of most countries.
- ▶ According to their teachers, internationally 55 percent of the eighth-grade students were receiving mathematics instruction emphasizing a combination of algebra, geometry, and number sense; about 27 percent instruction emphasizing algebra or algebra combined with geometry; and 14 percent instruction in mainly number. Very few students were given an emphasis in only geometry (three percent).

Instructional Contexts and Practices

- ▶ Internationally, 60 percent of eighth-grade students were taught mathematics by females and 40 percent by males, and similar percentages were found in a number of countries.
- ▶ Teachers' undergraduate and graduate studies provide some indication of their preparation to teach mathematics. Internationally, 84 percent of students were taught by teachers having mathematics and/or mathematics education as a major area of study.
- ▶ The TIMSS 1999 results show higher achievement is related to higher levels of teachers' confidence in their preparation to teach mathematics. Internationally, teachers reported relatively high degrees of confidence, with 63 percent of students taught by teachers who believed they were very well prepared.
- ▶ The percentage of instructional time at the eighth grade that was devoted to mathematics ranged from 9 to 17 percent. For the most part, the percentages reported by teachers corresponded with the percentages targeted in the intended curriculum.
- ▶ In 1999, teachers reported that approximately half the students were in mathematics classes that met between about two and three and a half hours per week, and another third were in classes meeting about three and a half to five hours. Compared with 1995, this represents a slight increase (five percentage points) for the shorter time period and a commensurate decrease for the longer time period.
- ▶ Videotapes of mathematics classes in the United States and Japan in TIMSS 1995 revealed that outside interruptions can affect the flow of the lesson and detract from instructional time. Internationally in 1999, about one-fifth of the students reported that their mathematics classes were interrupted pretty often or almost always, and 28 percent reported that their classes were never interrupted. In comparison, more than half the students in Japan, Korea, and Tunisia were in classes with no interruptions.
- ▶ Across the participating countries, teachers reported that the two most predominant activities encountered in mathematics class are teacher lecture and teacher-guided student practice, accounting for nearly half of class time.

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- ▶ Students in classes emphasizing reasoning and problem-solving had higher achievement than those in classes with a low emphasis on these activities. In Japan, nearly half the students were in classes involving reasoning and problem-solving activities in most lessons. Across countries, however, the majority of students were asked to do such activities in some but not most lessons. There was some evidence of increased emphasis on problem-solving activities between 1995 and 1999. However, the percentage of students asked to practice their computational skills in most or every lesson also increased significantly between 1995 and 1999.
 - ▶ In the Netherlands, Singapore, and Australia, more than four-fifths of the students and their teachers reported at least weekly calculator use. From about two-thirds to four-fifths in England, Canada, New Zealand, Hong Kong, Israel, and the United States reported this level of calculator use. Calculators were used most frequently to check answers, perform routine computations, and solve complex problems. At the other end of the spectrum, a majority of students and their teachers reported using calculators infrequently or never in a number of countries, including Chinese Taipei, Iran, Japan, Korea, Malaysia, the Philippines, Romania, Thailand, and Turkey.
 - ▶ Across countries, the vast majority of students (80 percent) reported never using computers in mathematics class. The trend data from 1995 to 1999, however, show a small but statistically significant shift from the “never” to the “once in while” category. Although there was great variation across countries, about a quarter of the students internationally reported Internet access at school. Despite this access, only 10 percent on average used the Internet to obtain information for mathematics projects on even a monthly basis.

School Factors

- ▶ Students in schools that reported being well resourced generally had higher average mathematics achievement than those in schools where across-the-board shortages affected instructional capacity in mathematics some or a lot. According to their principals, nearly half the students were in schools where instruction was negatively affected by shortages or inadequacies in instructional materials, budget for supplies, school buildings, instructional space, audio-visual resources, and library materials relevant to mathematics instruction. More than half the students were in schools where shortages or inadequacies in computers and computer software affected the capacity to provide mathematics instruction. Countries seemed to have computers either in nearly all of their schools or in only a fraction of them.
- ▶ Clearly schools around the world expect help from parents. Internationally, 85 percent of students attended schools expecting parents to ensure that their children complete their homework, 79 percent attended schools expecting parents to volunteer for school projects or field trips, and about half attended schools expecting parents to help raise funds and to serve on committees.
- ▶ Internationally, one-fifth of the students attended schools where principals reported that attendance was not a problem. However, 60 percent were in schools where principals reported moderate attendance problems, and 19 percent were in schools with some serious attendance problems.
- ▶ Generally, the overwhelming majority of eighth-grade students attended schools judged by principals to have few serious problems threatening an orderly or safe school environment.

