

Executive Summary

conducted every four years since 1995. In 2011, nationally representative samples of students in 63 countries and 14 benchmarking entities (regional jurisdictions of countries, such as states) participated in TIMSS. Countries and benchmarking participants could elect to participate in the fourth grade assessment, the eighth grade assessment, or both: 22 countries and seven benchmarking entities participated in the fourth grade assessment, and 45 countries and 14 benchmarking entities participated in the eighth grade assessment. Several of the countries, where fourth and eighth grade students were expected to find the TIMSS assessments too difficult, administered the fourth and eighth grade assessments to their sixth and ninth grade students.

In total, more than 600,000 students participated in TIMSS 2011. TIMSS 2011 continues the series of international assessments in mathematics and science conducted by the International Association for the Evaluation of Educational

IEA pioneered international comparative assessments of educational achievement in the 1960s to gain a deeper understanding of the effects of policies and practices across countries' different systems of education. TIMSS is directed by IEA's TIMSS & PIRLS International Study Center at Boston College.

The TIMSS science assessment is based on a comprehensive framework developed collaboratively with the participating countries that is organized around two dimensions:

At the eighth grade, there was more balance between science achievement growth and decline among countries, although more countries had increases than at the fourth grade. Of the 25 countries and eight benchmarking participants with comparable data spanning from 1995 or 1999 to 2011, eleven countries had increased achievement and six countries had decreased achievement. In addition, three benchmarking participants had increased achievement—the Canadian province of Ontario and the US states of Massachusetts and North Carolina—while the Canadian province of Québec had decreased achievement.

Trends Between 1995 or 1999* and 2011, Eighth Grade

Country	Trend
Chile	Increased
Hong Kong SAR	Increased
Iran	Increased
Japan	Decreased
Korea	Increased
Lithuania	Decreased
Russian Federation	Decreased
Singapore	Decreased
Slovenia	Decreased
Tunisia	Decreased
United States	Increased
Hungary	Decreased
Macedonia	Decreased
Malaysia	Decreased
Norway	Decreased
Sweden	Decreased
Thailand	Decreased

*The 1999 assessment only was given at the eighth grade, and a number of countries joined at that time.

Overview of TIMSS 2011 International Benchmarks, Eighth Grade

- Communicate an understanding of complex and abstract concepts in biology, chemistry, physics, and earth science.
- Demonstrate understanding of concepts related to science cycles, systems, and principles.
- Apply understanding of basic scientific knowledge in various contexts.
- Recognize some basic facts from the life and physical sciences.

while the Canadian province of Québec had decreased achievement.

Trends at TIMSS International Benchmarks

TIMSS reports achievement at four points along the scale as international benchmarks: Advanced International Benchmark (625), High International Benchmark (550), Intermediate International Benchmark (475), and Low International Benchmark (400). At the fourth grade, reflecting the upward trends in average achievement, there were more improvements across the International Benchmarks in 2011 than there were declines. Six countries showed improvement at all four benchmarks between 1995 and 2011, raising the level of performance across the entire distribution of student achievement.

Reflecting less improvement across countries at the eighth grade, three countries declined since 1995 at all four benchmarks (Hungary, Sweden, and Norway), and only three countries improved at all four benchmarks.

High Percentages of East Asian Students Reach TIMSS International Benchmarks

At the fourth grade, Singapore and

More Countries Demonstrate Relative Strength in Knowing Science Than in Applying Scientific Knowledge or Reasoning

Generally, TIMSS 2011 participants with the highest achievement overall also had the highest achievement in the science content domains (e.g., biology and

Successful Schools Tend to Be Well-resourced

Ever since the Coleman report in 1966, researchers have recognized that the compositional characteristics of a school's student body can affect student achievement. To provide information on this topic, TIMSS routinely asks school principals to report on their students' economic home backgrounds and home language. While there was variation across countries, higher average science achievement was associated with students attending schools where a greater percentage of students had the following characteristics:

- Were from relatively affluent socioeconomic backgrounds; and

- Spoke the language of the TIMSS assessment as their first language.

For example, students were distributed relatively equally across three types of schools categorized by the affluence of their home backgrounds. At the fourth grade, 36 percent attended schools with relatively more students from affluent than from economically disadvantaged homes, and these students had the highest average achievement. At the other end of the range, 30 percent of students attended schools with relatively more students from economically disadvantaged homes, and these students had the lowest average achievement.

Similarly, at the eighth grade, 32 percent attended schools with relatively more students from affluent than disadvantaged homes, and these students had the highest average achievement. Conversely, 36 percent of students attended schools with relatively more students from economically disadvantaged homes, and these students had the lowest average achievement.

Successful Schools
Emphasize Academic
Success and Have Safe and
Orderly Environments

In contrast, schools with discipline and safety problems are not conducive to high achievement. The sense of security that comes from attending a school with few behavior problems and having little or no concern about student or teacher safety promotes a stable learning environment. To create the School Discipline and Safety scale, principals provided their perceptions about the degree to which a series of ten discipline, disorderly, and bullying behaviors were problems in their schools.

At both the fourth and eighth grades, students who attended schools with disorderly environments and who reported more frequent bullying had much lower achievement than their counterparts in safe and orderly schools. Interestingly, across the fourth grade countries, 61 percent of students, on average, attended schools with **Hardly Any Problems** with discipline or safety, 29 percent were in schools with **Minor Problems**, and 11 percent attended schools with **Moderate Problems**.

Across the eighth grade countries, however, discipline appeared to be more of an issue; principals reported that only 16 percent of students were in schools with **Hardly Any Problems**, 66 percent were in schools with **Minor Problems**, and 18 percent attended schools with **Moderate Problems**.

Teacher Preparation and Career Satisfaction Related to Higher Science Achievement

In view of the importance of a well-prepared teaching force to an effective education, TIMSS 2011 collected a variety of information about teacher education. Internationally, most students were taught by the following:

Students with Positive Attitudes Toward Science Have Higher Achievement, but Attitudes Less Positive at the Eighth Grade

Each successive TIMSS assessment has shown a strong positive relationship within countries between student attitudes toward science and their science achievement. The relationship is bidirectional, with attitudes and achievement mutually influencing each other.

The Students Like Learning Science scale was based on students' degree of agreement with six statements, such as "I enjoy learning science" and "I learn many interesting things in science." Internationally, more than half of the fourth grade students **Like Learning Science**, and they had higher average achievement than those that **Somewhat Like Learning Science** (35%) or those that **Do Not Like Learning Science** (12%).

At the eighth grade, 16 of the TIMSS countries teach science subjects separately (i.e., biology, chemistry, physics, and earth science) rather than as a general or integrated subject. TIMSS asked students in these countries about their liking of the individual subjects and the results were scaled separately for each subject. Compared to the fourth grade, substantially fewer eighth grade students reported positive attitudes toward learning science. Among countries teaching general or integrated science, only about one-third (35%) of students **Like Learning Science**, compared to 53 percent at the fourth grade. Accompanying this decrease is a widening achievement gap between students who like learning the subject (515, on average) and those who do not (450).

Among separate science subject countries, the average percentage of

The Students Confidence in Science scale includes six statements (nine at the eighth grade), such as "Science is harder for me than for many of my classmates" (reverse coded) and "My teachers tells me I am good at science." Internationally, just 43 percent of the fourth grade students expressed confidence in their science ability, but their science achievement was higher than for the students who felt **Somewhat Confident**. The students lacking confidence (21%) had the lowest achievement.

At the eighth grade, only 20 percent of the students in general or integrated science countries, on average internationally, felt **Confident** in their science ability, with most students either **Somewhat Confident** (49%) or **Not Confident** (31%). The achievement gap was 86 points between the **Confident** and **Not Confident** students.

The eighth grade students in separate science countries were similar to students in general or integrated countries in their confidence in biology and earth science (21% and 19% **Confident**

From the students' perspective, the Engaged in Science Lessons scale asked how much students agreed with five statements, such as "I know what my teacher expects me to do" and "I am interested in what my teacher says." Internationally, the fourth grade students **Engaged** in their science lessons (45%) had the highest achievement, followed by those **Somewhat Engaged** (47%) and the few students **Not Engaged** (8%). At the eighth grade, internationally, smaller percentages of students reported being **Engaged**. In countries teaching general or integrated science, only 29 percent of students, on average, reported being **Engaged** during their science lessons, although these students had the highest average achievement. Among the separate science subject countries, students reported somewhat more engagement

There was greater use of investigation in science instruction at the eighth grade, with almost half of the students (48%) taught by teachers emphasizing investigation in **About Half the Lessons or More**. Also, science achievement was slightly high

