

TIMSS 2011 Assessment Frameworks



Introduction



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Overview of TIMSS

Preparing students to excel in mathematics and science is one of the fundamental education goals in countries around the world. Studying mathematics and science during their early years of schooling prepares children to succeed in future educational endeavors and eventually in daily life and the workforce. Effective participation in society increasingly requires understanding of mathematics and science to make informed decisions about personal health and finance as well as about public policy concerning such issues as the environment and economy.

Because of the educational importance of mathematics and science, IEA's Trends in International Mathematics and Science Study, widely known as TIMSS, is dedicated to providing countries with information to improve teaching and learning in these curriculum areas. Conducted every four years on a regular cycle, TIMSS assesses achievement in mathematics and science at the fourth and eighth grades. The achievement data are collected together with extensive background information about the availability of school resources and the quality of curriculum and instruction. TIMSS provides countries with an unprecedented opportunity to measure progress in educational achievement in mathematics and science together with empirical information about the contexts for schooling.

As a project of the International Association for the Evaluation of Educational Achievement (IEA), TIMSS has the benefit of drawing on the cooperative expertise provided by representatives from countries all around the world. The IEA is an independent

international cooperative of national research institutions and government agencies that has been conducting studies of cross-national achievement since 1959. As of 2009, IEA had 68 institutional members. TIMSS is directed by the TIMSS & PIRLS International Study Center at Boston College.

Monitoring Trends

TIMSS 2011 is the most recent in the TIMSS series, which began with the first assessment in 1995 and has continued with subsequent assessments in 1999, 2003, and 2007. For countries with data back to 1995, TIMSS 2011 will provide the fifth trend measure. Approximately 60 countries have TIMSS trend data, and new countries join TIMSS in each cycle. Nearly 70 countries are expected to participate in TIMSS 2011. Additionally, to provide each participating country with an extensive resource for interpreting its achievement results and to track changes in curriculum and instructional practices, TIMSS asks students, their teachers, and their school principals to complete questionnaires about the contexts for learning mathematics and science. TIMSS also collects detailed information about the mathematics and science curricula in each country. Trend data from these questionnaires provide a dynamic picture of changes in the implementation of educational policies and practices and help to raise new issues relevant to improvement efforts.

The results from the TIMSS 2007 mathematics and science assessments were reported in two companion volumes: the *TIMSS 2007 International Mathematics Report* (Mullis, Martin, & Foy, 2008) and the *TIMSS 2007 International Science Report* (Martin, Mullis, & Foy, 2008). These reports contain the results from the TIMSS 2007 mathematics and science assessments at the fourth and eighth grades, including trends over time in achievement and the educational contexts for mathematics and science instruction. Through the

years, TIMSS data have had an enduring impact on reform and development efforts in mathematics and science education around the world, leading on one hand to continuing demand for trend data to monitor development and on the other hand to a need for more and better policy-relevant information to guide and evaluate new initiatives.

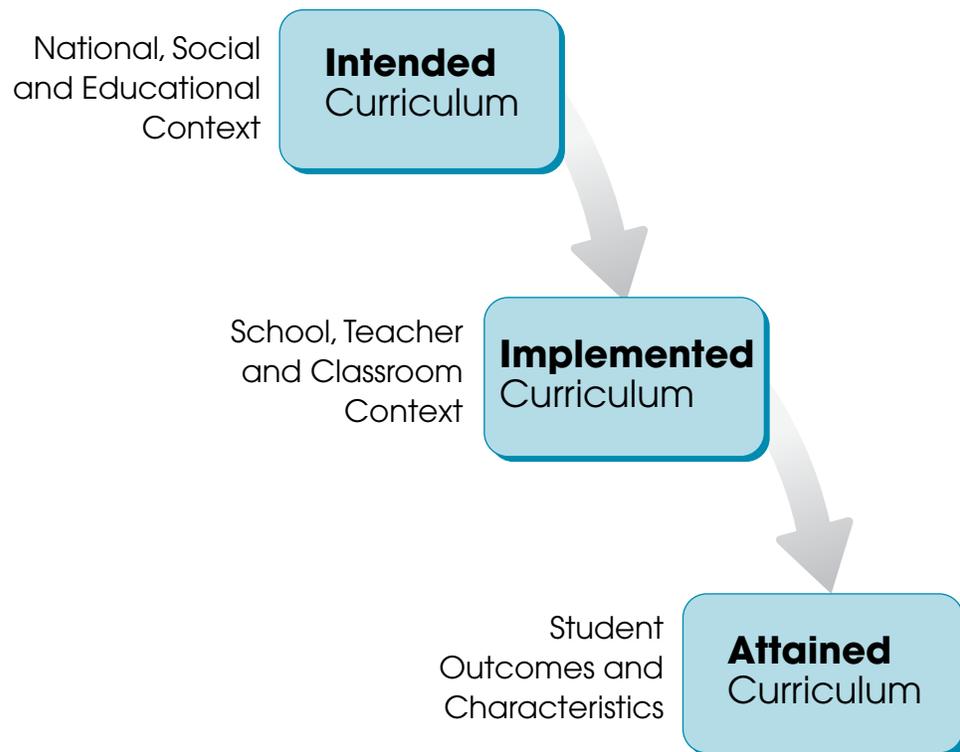
The TIMSS 2011 Assessment Frameworks

This publication, the *TIMSS 2011 Assessment Frameworks*, contains three frameworks and explains the assessment design that will serve as the basis for implementing TIMSS 2011. The *TIMSS 2011 Mathematics Framework* and the *TIMSS 2011 Science Framework* in Chapters 1 and 2, respectively, describe in some detail the major content and cognitive domains in mathematics and science to be tested at the fourth and eighth grades. The content domains (for example, algebra, geometry, etc. in mathematics, and biology, chemistry, etc. in science) and the topic areas within the domains are described separately for the fourth and eighth grades with each topic area elaborated with specific objectives. The cognitive domains describing the thinking students should be doing within the mathematics and science content domains are the same for mathematics and science and parallel across grades, but with different levels of emphasis. Chapter 3 contains the *TIMSS 2011 Contextual Framework* describing the types of situations and factors associated with students' learning in mathematics and science that will be investigated via the questionnaires. Finally, Chapter 4 provides an overview of the *TIMSS 2011 Assessment Design*, including general parameters for item development.

The TIMSS Curriculum Model

Building on earlier IEA studies of mathematics and science achievement, TIMSS uses the curriculum, broadly defined, as the major organizing concept in considering how educational opportunities are provided to students, and the factors that influence how students use these opportunities. The TIMSS curriculum model has three aspects: the intended curriculum, the implemented curriculum, and the achieved curriculum (see Exhibit 1). These represent, respectively, the mathematics and science that society intends for students to learn and how the education system should be organized to facilitate this learning; what is actually taught in classrooms, the characteristics of those teaching it, and how it is taught; and, finally, what it is that students have learned, and what they think about these subjects.

Exhibit 1: TIMSS Curriculum Model



Working from this model, TIMSS uses mathematics and science achievement tests to describe student learning in the participating countries, together with the TIMSS Encyclopedia and questionnaires, to provide extensive information about students' opportunity to learn. TIMSS asks countries to provide information about the level of mathematics and science students are expected to learn via the TIMSS Encyclopedia and the curriculum questionnaires. For example, the *TIMSS 2007 Encyclopedia* (Mullis, Martin, Olson, Berger, Milne, & Stanco, 2008) provided information from the countries participating in TIMSS 2007 about their national contexts for mathematics and science education as well as descriptions of their mathematics and science curricula. The more qualitative information provided in the *TIMSS 2007 Encyclopedia* complements both the *TIMSS 2007 International Mathematics Report* and the *TIMSS 2007 International Science Report*. The international reports contain extensive questionnaire data about the structure and rigor of the intended curriculum in mathematics and the efforts extended to help students actually learn the curriculum. For example, the questionnaire data include teachers' reports about their preparation, experience, and attitudes; the mathematics and science content actually taught to the students assessed for TIMSS; the instructional approaches used in teaching mathematics and science; and the resources available in classrooms and schools to support mathematics and science teaching and learning.

The Development Process for the TIMSS 2011 Assessment Frameworks

The TIMSS assessment frameworks for 2011 were updated from those used in the *TIMSS 2007 Assessment Frameworks* (Mullis, Martin, Ruddock, O'Sullivan, Arora, & Erberber, 2005). Updating the frameworks regularly provides participating countries greater

opportunity to review and provide information about the frameworks and results in more coherence from assessment to assessment, permitting the frameworks, the instruments, and the procedures to evolve gradually into the future.

For TIMSS 2011, the frameworks were discussed by representatives of the participating countries at their first meeting. Each country identifies a TIMSS National Research Coordinator (NRC) to work with the international project staff to ensure that the study is responsive to the country's concerns. The NRCs are responsible for implementing the study in their countries in accordance with TIMSS methods and procedures. The NRCs also consulted with their national experts and responded to questionnaires about how best to update the content and cognitive domains for TIMSS 2011. The questionnaires attempted to garner each country's views about adding or deleting particular assessment topic areas and objectives.

Revised on the basis of input from the participating countries, the frameworks were reviewed in-depth by the TIMSS 2011 Science and Mathematics Item Review Committee (SMIRC). Using an iterative process, the frameworks as revised by SMIRC were once again reviewed by the NRCs and updated finally prior to publication. The *TIMSS 2011 Assessment Frameworks* document closely resembles that for TIMSS 2007. Since it is crucial to have continuity in a study designed to measure trends in educational achievement over time, this is very appropriate. However, there are some notable revisions.

In the discussions about updating the frameworks held by the NRCs and the SMIRC as well as by the IEA and TIMSS management and technical groups, the emphasis has been on improving the quality of measurement in the assessments for TIMSS 2011 and on increasing the utility of results for participating countries. This includes assessing content appropriate to the students and important to their future lives, ensuring adequate response time for students,

increasing operational feasibility, and maximizing the potential to improve reporting achievement in the content and cognitive domains assessed.

TIMSS and PIRLS in 2011

To be particularly relevant to decision-making and implementing school policy, TIMSS assesses students at two important educational milestones—at the end of four years of formal schooling (end of primary school) and the end of eight years of formal schooling (end of lower-secondary education). Because TIMSS studies the effectiveness of curriculum and instruction in relation to student achievement, it is important for TIMSS to assess mathematics and science achievement at the same point in schooling across countries. That is, for fair comparisons, students should have had the opportunity to learn mathematics and science for an equivalent number of years of formal schooling.

TIMSS data complement IEA's Progress in International Reading Literacy Study (PIRLS) conducted at the fourth grade. By participating in TIMSS and PIRLS, countries can have information at regular intervals about how well their students read and what they know and can do in mathematics and science. 2011 presents a unique opportunity for international assessment at the fourth grade, because the four-year cycle of TIMSS will be in alignment with the five-year cycle of PIRLS. PIRLS is being conducted for the third time in 2011 after assessments in 2001 and 2006.

Because IEA's TIMSS and PIRLS international assessments both will be conducted in 2011, countries have the opportunity to conduct a comprehensive assessment of mathematics, science, and reading at the fourth grade. This will enable countries to profile students' relative strengths in mathematics, science, and reading in an international context. The assessments will include an extensive

array of contextual background information for improving teaching and learning in these three basic curriculum areas. Since PIRLS has a questionnaire administered to students' parents or caregivers, participation in TIMSS together with PIRLS gives countries an opportunity to collect information from parents about early learning in mathematics and science as well as other characteristics of students' home environments.

What is the value of TIMSS?

TIMSS provides valuable information that helps countries monitor and evaluate their mathematics and science teaching across time and across grades. More information about TIMSS can be found on the website: <http://timssandpirls.bc.edu>

By participating in TIMSS, countries can:

- Have comprehensive and internationally comparable data about what mathematics and science concepts, processes, and attitudes students have learned by the fourth and eighth grades.
- Assess progress internationally in mathematics and science learning across time for students at the fourth grade and for students at the eighth grade.
- Identify aspects of growth in mathematical and scientific knowledge and skills from fourth grade to eighth grade.
- Monitor the relative effectiveness of teaching and learning at the fourth as compared to the eighth grade, since the cohort of fourth-grade students is assessed again as eighth graders.

- Understand the contexts in which students learn best. TIMSS enables international comparisons among the key policy variables in curriculum, instruction, and resources that result in higher levels of student achievement.
- Use TIMSS to address internal policy issues. Within countries, for example, TIMSS provides an opportunity to examine the performance of population subgroups and address equity concerns. It is efficient for countries to add questions of national importance (national options) as part of their data collection effort.

