

## Overview of TIMSS

IEA's Trends in International Mathematics and Science Study (TIMSS) provides information to improve teaching and learning in mathematics and science. TIMSS assesses achievement in mathematics and science at the fourth and eighth grades and collects a rich array of background information to address concerns about school resources and the quality of curriculum and instruction. Conducted every four years on a regular cycle, TIMSS provides countries with an unprecedented opportunity to measure progress in educational achievement in mathematics and science.

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 2005, IEA had 62 institutional members.

TIMSS 2007 is the most recent in the series of IEA studies to measure trends in students' mathematics and science achievement. The first cycle of TIMSS was in 1995 in 41 countries. The second cycle in 1999 involved 38 countries (26 were able to measure trends). Continuing the regular cycle of studies at four-year intervals, TIMSS 2003 involved more than 50 countries and approximately 60 countries are expected to participate in TIMSS 2007. Nearly 40 of these countries will have trend data, some covering more than a decade back to 1995.

Additionally, to provide each participating country with an extensive resource for interpreting the 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.

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 to a need for more and better policy-relevant information to guide and evaluate new initiatives.

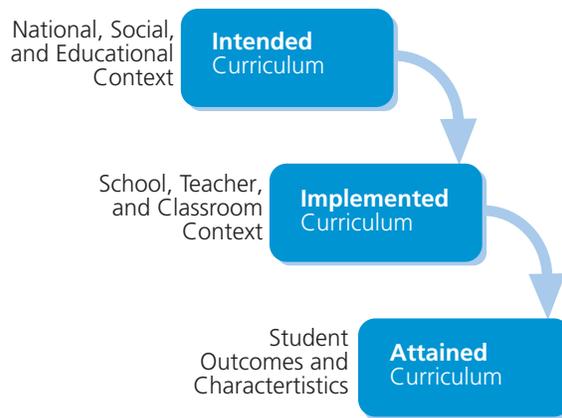
## **The TIMSS 2007 Assessment Frameworks**

This publication, the *TIMSS 2007 Assessment Frameworks*, contains three frameworks and explains the assessment design that will serve as the basis for implementing TIMSS 2007. The Mathematics Framework and the 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 and topic areas are described separately for the fourth and eighth grades with each topic area elaborated with specific objectives. Within mathematics and science, the cognitive domains are parallel across grades, but with different levels of emphasis. The Contextual Framework in Chapter 3 describes the types of factors and contexts associated with students' learning in mathematics and science that will be investigated via the questionnaires. Finally, Chapter 4 provides an overview of the 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, who teaches 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 questionnaires to provide a wealth of information. The questionnaires ask about the structure and content of the intended curriculum in mathematics and science, the preparation, experience, and attitudes of teachers, the mathematics and science content actually taught, the instructional approaches used, the organization and resources of schools and classrooms, and the experiences and attitudes of the students in the schools.

## The Development Process for the TIMSS 2007 Assessment Frameworks

The TIMSS Assessment Frameworks for 2007 rely heavily on the extensive effort expended to update the frameworks for TIMSS 2003. For TIMSS 2003, the TIMSS & PIRLS International Study Center engaged in a lengthy and intensive process to update the frameworks used in 1995 and 1999. Supported by the U.S. National Science Foundation, this process involved widespread participation and reviews by educators around the world to ensure the frameworks were appropriate for the many TIMSS countries. To permit the content assessed by TIMSS to evolve, the frameworks used in the 1990s were revised to reflect changes during the last decade in curricula and the way mathematics and science are taught. In particular, for the first time, the Mathematics

and Science Frameworks were expanded to provide specific objectives for assessing students at the fourth and eighth grades.

An international panel of mathematics and science education and testing experts provided guidance for the general form the assessment frameworks should take and representatives from national centers in the participating countries were asked to play an important role in contributing critiques and advice as the frameworks were developed. Using an iterative process, successive drafts were presented for comment and review by the TIMSS 2003 National Research Coordinators (NRCs), national committees within participating countries, and expert panel members.

The participating countries completed detailed questionnaires, providing valuable feedback about the topics included in their curricula and the suitability and desirability of assessing particular topics at the fourth and eighth grades. As such, the frameworks do not consist solely of content and behaviors included in the curricula of all participating countries. The aim of the thorough consultation on curriculum within countries was to ensure that goals of mathematics and science education regarded as important in a significant number of countries were included.

Beginning with TIMSS 2007, IEA and the TIMSS & PIRLS International Study Center have decided to update the TIMSS Assessment Frameworks with every cycle. 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 2007, the frameworks were discussed by the NRCs at their first meeting. Participating countries also consulted with their national experts and responded to questionnaires about the possibility of combining some content areas receiving low priority in previous assessments to improve the potential for measuring trends over time in content areas. The questionnaires also 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 2007 Science and Mathematics Item Review Committee (SMIRC). Using an iterative process, the frameworks as further revised by SMIRC were once again reviewed by the NRCs and updated finally prior to publication.

The *TIMSS 2007 Assessment Frameworks* document closely resembles that for TIMSS 2003. 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 Mathematics and Science Frameworks, the content domains are presented separately for the fourth and eighth grades, and there has been a concerted effort to better reflect fourth-grade curricula. At both grades, there was an effort to consolidate the major content areas and adjust the assessment topic areas and objectives to make them more appropriate and feasible in the context of a large-scale international assessment.

The cognitive domains in the Mathematics and Science Frameworks also have been revised for TIMSS 2007. To increase the potential for analyzing and reporting the mathematics and science results according to cognitive domains, the U.S. National Center for Education Statistics provided support to examine and refine the mathematics cognitive domains used in TIMSS 2003. The issue of reporting results for cognitive domains in both mathematics and science was discussed by the NRCs, and the SMIRC mathematics and science experts worked to recast the cognitive domains in mathematics and science, respectively, to develop a classification scheme that encompassed the important cognitive domains assessed by TIMSS while sharpening the distinction among mutually exclusive categories. These revisions were reviewed by the TIMSS 2007 NRCs in parallel with the updates to the content domains.

The Contextual Framework for TIMSS 2007 has changed little from TIMSS 2003, being modified simply to reflect updates to the TIMSS questionnaires given to students, their teachers, and their principles as well as the questionnaires completed by countries about the topics covered in their intended curricula. The Assessment Design, however,

has been modified to ensure that students have ample response time and to have a more straightforward booklet design.

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 2007 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.

## **More About TIMSS<sup>1</sup>**

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. TIMSS also complements the OECD's Programme for International Student Achievement (PISA), which assesses the mathematics, science, and reading literacy of 15-year-olds.

With each cycle, TIMSS releases test questions to the public and then replaces these with newly developed questions. To develop the

<sup>1</sup> For detailed information about TIMSS, please see the TIMSS websites: [timss.bc.edu](http://timss.bc.edu) and [www.iea.nl](http://www.iea.nl). Also, see the *TIMSS 2003 International Mathematics Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades*. Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., & Chrostowski, S.J. (2004). Chestnut Hill, MA: Boston College and the *TIMSS 2003 International Science Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades*. Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., & Chrostowski, S.J. (2004). Chestnut Hill, MA: Boston College.

new questions, the TIMSS & PIRLS International Study Center works with representatives from the participating countries to develop items that measure objectives in the frameworks and adhere to the TIMSS guidelines. The items then undergo an extensive review process involving numerous experts in education, mathematics, science, and measurement, including the SMIRC and the NRCs. The items are field tested in each of the participating countries and then reviewed again by SMIRC and the NRCs prior to selection for data collection.

The tests contain questions asking students to select appropriate responses or to solve problems and answer questions in formats requiring them to construct their own answers. Beginning in TIMSS 2003, an effort was made to place more emphasis on questions and tasks that offer better insight into students' analytical, problem-solving, and inquiry skills and capabilities. Subsequent to instrument development and production, TIMSS is administered to representative samples of students in the participating countries. An enormous amount of energy is devoted to ensuring high quality data. Attention is given to meeting rigorous standards every step of the way through sampling, translation verification, instrument production, test administration, scoring, database construction and documentation, analysis, scaling, reporting, technical documentation, dissemination of the database, and training in how to use the data for secondary analyses.

TIMSS is a major undertaking of the IEA, and together with PIRLS, comprises the core of IEA's regular cycles of studies. IEA has entrusted responsibility for the overall direction and management of the project to its TIMSS & PIRLS International Study Center at Boston College. In carrying out TIMSS, the TIMSS & PIRLS International Study Center works closely with the IEA Secretariat in Amsterdam on country membership and translations verification, the IEA Data Processing Center in Hamburg on database creation and documentation, Statistics Canada in Ottawa on sampling, and Educational Testing Service in Princeton, New Jersey on the psychometric scaling of the data.

## What is the value of TIMSS?

TIMSS helps countries monitor and evaluate their mathematics and science teaching across time and across grades. 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.