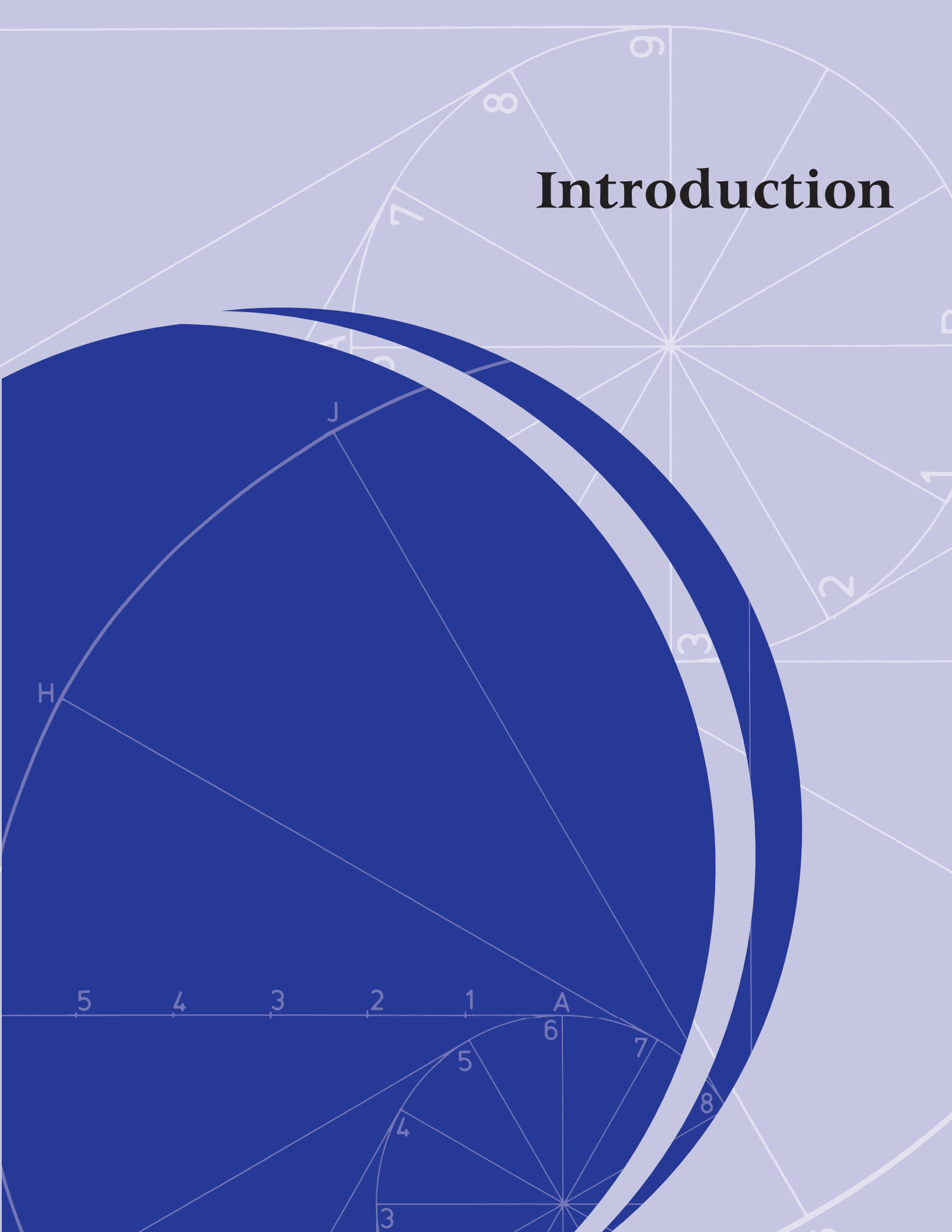
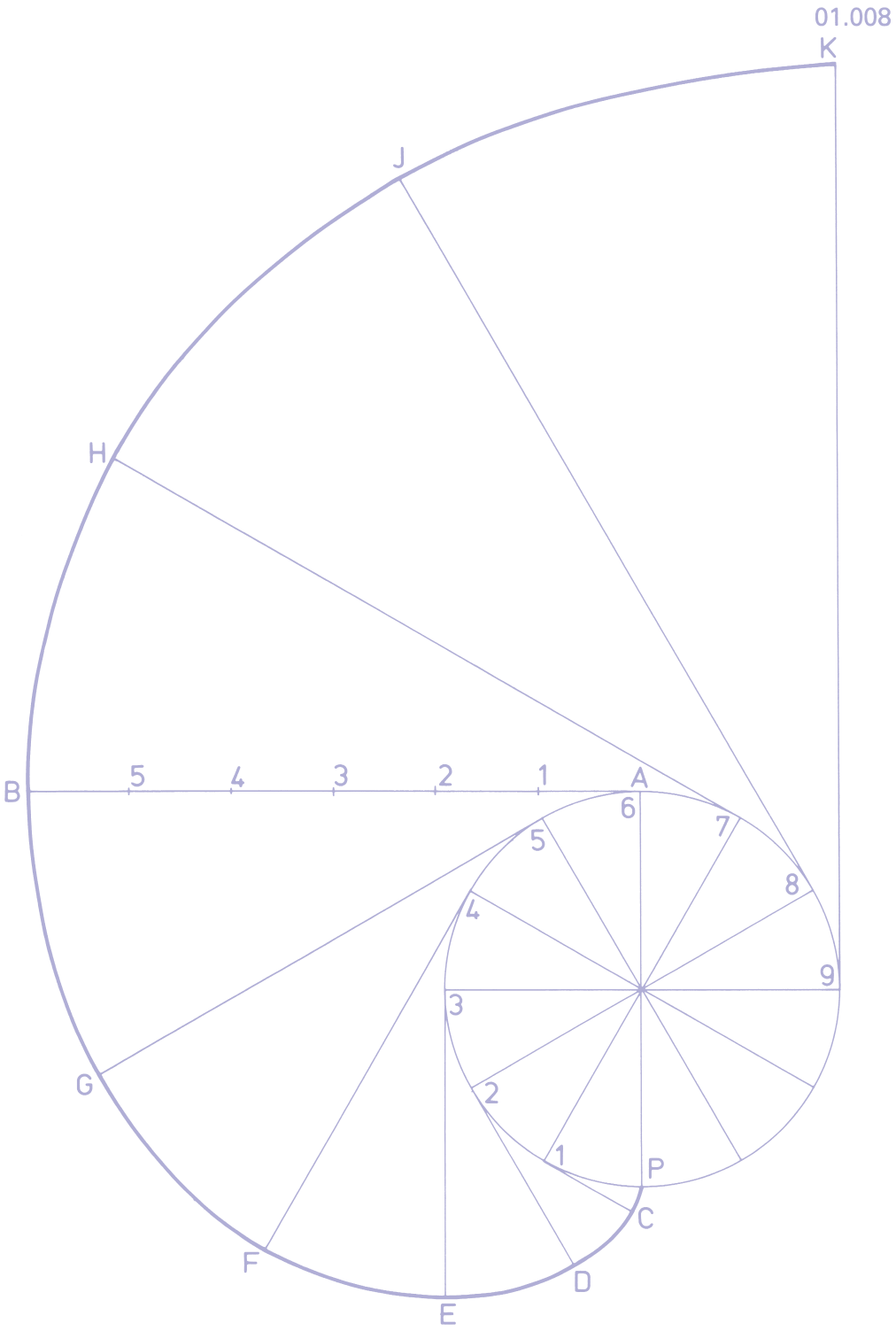
Introduction





Introduction

Overview

The Trends in International Mathematics and Science Study (TIMSS[1]) is a project of the International Association for the Evaluation of Educational Achievement (IEA). 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.

TIMSS 2003 is the most recent in the series of IEA studies to measure trends in students' mathematics and science achievement. Offered first in 1995 and then in 1999, the regular cycle of TIMSS studies provides countries with an unprecedented opportunity to measure progress in educational achievement in mathematics and science.

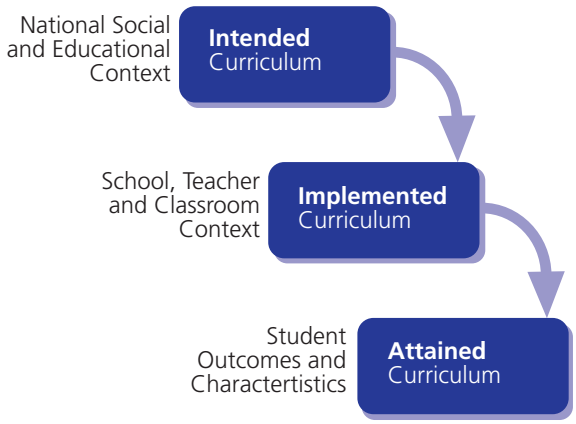
Additionally, to provide each participating country with a rich resource for interpreting the achievement results and to track changes in instructional practices, TIMSS asks students, their teachers, and their school principals to complete questionnaires about the contexts for learning mathematics and science. 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 developments and on the other to a need for more and better policy-relevant information to guide and evaluate new initiatives.[2]

This publication, the *TIMSS Assessment Frameworks and Specifications*, serves as the basis of TIMSS 2003 and beyond. It describes in some detail the mathematics and science content to be assessed in future assessments in mathematics and science. Topic areas are elaborated with objectives specific to grades 4 and 8. The TIMSS frameworks document also describes the contextual factors associated with students' learning in mathematics and science that will be investigated. Finally, it provides an overview of the assessment design and the guidelines 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

Exhibit 1: TIMSS Curriculum Model



1 Originally named the Third International Mathematics and Science Study.

2 Robitaille, D. F., Beaton, A. E., and Plomp, T., eds. (2000), *The Impact of TIMSS on the Teaching and Learning of Mathematics and Science*, Vancouver, BC: Pacific Educational Press.

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.

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 Assessment Frameworks and Specifications

Developing this document began by updating the *Curriculum Frameworks for Mathematics and Science*[3] used as the basis for the 1995 and 1999 assessments. This process involved widespread participation and reviews by educators around the world. To permit the content assessed by TIMSS to evolve, the frameworks were revised to reflect changes during the last decade in curricula and the way mathematics and science are taught. In particular, the frameworks were expanded to provide specific objectives for assessing students at grades 4 and 8, resulting in the specifications for the assessments in mathematics and science contained in this document.

To provide the basis for valid international tests, assessment frameworks require extensive international input. They must be appropriate for the levels of mathematics and science learning of the populations studied in the many TIMSS countries, and hence representatives from national centers were asked to play an important role in contributing critiques and advice as the frameworks were developed.

An international panel of mathematics and science education and testing experts provided guidance for the general form the assessment frameworks should take. The U.S. National Science Foundation provided support for the meetings and the work of the expert panel. Using an iterative process, successive drafts were presented for comment and review by National Research Coordinators (NRCs), national committees, and expert panel members. A detailed questionnaire to participating countries about

3 Robitaille, D.F., et al (1993), *TIMSS Monograph No. 1: Curriculum Frameworks for Mathematics and Science*, Vancouver, BC: Pacific Educational Press.

topics included in their curricula provided valuable feedback on the suitability of assessing individual mathematics and science topics at the fourth and eighth grades.

The frameworks do not consist solely of content and behaviors included in the curricula of all participating countries. The aim of the extensive consultation on curriculum was to ensure that goals of mathematics and science education regarded as important in a significant number of countries are included. The ability of policy makers to make sound judgments about relative strengths and weaknesses of mathematics and science education in their systems depends on achievement measures being based, as closely as possible, on what students in their systems have actually been taught. This is also a prerequisite for valid use of the measures in many potential secondary analyses.

The following factors were considered in finalizing the content domains and the topics and objectives of the assessment frameworks:

- Inclusion of the content in the curricula of a significant number of participating countries
- Alignment of the content domains with the reporting categories of TIMSS 1995 and TIMSS 1999
- The likely importance of the content to future developments in mathematics and science education
- Appropriateness for the populations of students being assessed
- Suitability for being assessed in a large-scale international study
- Contribution to overall test balance and coverage of content and cognitive domains.

The TIMSS Tests

The overriding principle in constructing tests for the upcoming cycles of the study is to produce assessment instruments that will generate achievement data that are valid for the purposes they are to be used for, and are reliable. Based on the frameworks, the TIMSS tests are developed through an international consensus-building process involving input from experts in education, mathematics, science, and measurement. The tests contain questions requiring students to select appropriate responses or to solve problems and answer questions in an open-ended format. With each cycle, TIMSS releases test questions to the public and then replaces these with newly developed questions. As in earlier phases of TIMSS, most test items, while focusing on a particular content element, will also assume knowledge or skills from one or more other content areas. Additionally, some topics have been stated more broadly, and it is expected that a number of the newly developed items will require students to synthesize knowledge and skills from more than one topic. From 2003 on, TIMSS will gradually place more emphasis on questions and tasks that offer better insight into students' analytical, problem-solving, and inquiry skills and capabilities. To facilitate innovations in assessment instrumentation, the plan calls for incorporating investigative- or production-based tasks into the tests to the extent possible.

TIMSS test results can be used for a variety of purposes. Policy makers and researchers can look forward to achievement data in mathematics and science overall and in major content areas that:

- Extend and strengthen measurement of trends in mathematics and science begun in TIMSS 1995 and continued in TIMSS 1999
- Allow informed between-country comparisons of achievement and, in conjunction with other TIMSS data, suggest reasons for differences
- Enhance evaluation of the efficacy of mathematics and science teaching and learning within each country
- Highlight aspects of growth in mathematical and scientific knowledge and skills from grade 4 to grade 8
- Provide data for secondary analyses concerned with raising achievement levels through better-informed policy making in education systems and schools, and improved teaching practice.

Student Populations Assessed

TIMSS 2003 will assess the mathematics and science achievement of children in two target populations. One target population, sometimes referred to as Population 1, includes children ages 9 and 10. It is defined as "the upper of the two adjacent grades with the most 9-year-olds." In most countries, this is the fourth grade. The other target population, sometimes referred to as Population 2, includes children ages 13 and 14, and is defined as "the upper of the two adjacent grades with the most 13-year-olds." In most countries, this is the eighth grade. Thus, through the remainder of this document, the grades assessed will be described as the fourth and eighth grades.

By assessing these grades using the same target populations as in 1995 and 1999, TIMSS 2003 can provide trend data at three points over an eight-year period. In addition, TIMSS data will complement IEA's Progress in International Reading Literacy Study (PIRLS) being conducted in 2001 at the fourth grade. By participating in PIRLS and TIMSS, countries will 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 another international study of student achievement, the OECD's Programme for International Student Achievement (PISA), which assesses the mathematics and science literacy of 15-year-olds.